MOJAVE BASIN AND RANGE
RAPID ECOREGIONAL ASSESSMENT
FINAL MEMORANDUM I-1-C

Prepared for:
Department of the Interior
Bureau of Land Management
Rapid Ecoregional Assessments

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Executive Summary

Rapid Ecoregional Assessments (REAs) are the first step in the Bureau's Landscape Approach. REAs are intended to synthesize existing knowledge and information applicable to all lands and waters within the ecoregion. This synthesis aims to inform subsequent decision making, implementation, and monitoring by BLM and partners within the ecoregion, and should interact with ongoing scientific research as a foundation for science-based land management. REAs are organized into a series of phases and component tasks. Phase 1 includes tasks that clarify the scope, expected data and modeling approaches to be used, and culminating in a detailed workplan for the analysis. Phase 2 completes the preparation of data, conducts agreed-upon analyses, and documents assessment results. This memorandum summarizes the work, decisions, and remaining issues to be resolved for Task 1, Phase 1 for the Mojave Basin and Range Ecoregion. Here we initiate the assessment to scope the overall effort, clarify key management questions to be answered, define the ecoregion, establish our criteria and approach for treating selecting and treating focal Conservation Elements, and determine the relevant Change Agents that will be addressed. This memorandum is the final draft (1-c) which incorporates comments on the first draft (Memorandum 1-a) provided at AMT Workshop 1 or submitted separately to BLM.

Task 1 Objectives

The objectives of Task 1 were:

1. Define the assessment region as the ecoregion and a buffer
2. Create a conceptual ecoregion model
3. Review and assess proposed management questions
4. Review and assess proposed conservation elements (CEs)
5. Review and assess proposed change agents (CAs)
6. Conduct a review of recommendations with the AMT
7. Complete initial recommendations to feed into Task 2 data assessment

Ecological Models

Conceptual ecological models assist with organizing current knowledge and communicating key assumptions about the environmental controls and dynamics that characterize a given area. The purpose of our ecoregional model is to express key assumptions about regional landscape patterns and processes that will inform our selection and analysis of conservation elements and change agents; and provide a framework for a series of component models for the ecoregion. Here we adapted existing model concepts highlighting climatic regimes and regional physiographic pattern. These overarching controls vary according to differences in solar radiation and air density and seasonal temperature regimes along longitudinal, latitudinal, and elevational gradients. Seasonal precipitation regimes vary along these gradients but also with rain-shadow effects. Combined, these controlling regimes set up regional patterns in wind, dry/wet atmospheric deposition, and air quality.

We then defined the major model components; acknowledging the central role of water in this warm desert ecoregion, we first distinguish upland 'dry-land' ecosystems driven generally by water scarcity from aquatic, riparian, and wetland ecosystems driven by water flow regimes. Given the pervasive influence of interacting climate and physiography, we distinguish the major model components into "Montane Dry Land" vs. "Basin Dry Land" and "Montane Wet" vs. "Basin Wet" systems. The dry land systems include natural drivers of soil moisture infiltration, erosion, soil organic matter accumulation, and natural disturbance dynamics such as windthrow and wildfire. These vary considerably between higher, cooler montane settings and warmer basin settings. The Montane Dry Land System will be further characterized (in Phase 1 Task 3) by a series of submodels that encompass high elevation woodlands and forests, montane mixed conifer forests, pinyon-juniper woodlands, and montane chaparral, as well as montane cliff and canyon environments. The Basin Dry Land System will be further subdivided by a series of submodels for semi-desert shrublands, shrub steppe, desert scrub, desert cliff and outcrops, and sand dunes. Likewise, “wet” systems, including streams, larger rivers, lakes, springs, desert sinks, wetlands, and riparian environments, are strongly driven by seasonal water flow regimes and the relative influence of surface to groundwater dynamics. The Montane Wet System will be further subdivided by a series of submodels that encompass subalpine-to-montane streams and riparian communities. The Basin Wet System will be further subdivided by a series of submodels for low-elevation lakes, streams, desert springs, marshes, floodplain and riparian communities, desert washes, and playas.

The human dimension enters as a distinct component model, as socioeconomic and demographic drivers of change in land and water use and policy overlay on other model components. Natural drivers such as herbivory, wildfire, and biotic soil crust processes directly altered through exotic ungulate grazing regimes and altered fire regimes in the dry land systems. Predator/prey dynamics are influenced by human/wildlife conflicts, hunting, exotic ungulate (e.g. horse/burro) congregation, and collecting. Land conversion and introduction of invasive plant species closely follow human land use patterns for settlements, energy development (e.g., mining, oil/gas, solar, wind farms, geothermal), irrigated agriculture, or transportation/communication infrastructure. Within wet systems, the human dimension is expressed through water withdrawals or diversions, water pollution, wetland alterations through hydrologic alteration, conversion, exotic ungulate trampling, or introduction of invasive species.

Management Questions

Individual Management Questions (MQs) address specific needs for information that will ultimately inform BLM’s management actions on the landscape. Individual MQs are driven by an iterative dialog among three aspects of land management planning: (1) an understanding of the ecological systems and social context, (2) the entities that are of concern and are under management, and (3) the processes or activities that can effect change in the managed landscape.

A goal of Task 1 is to develop a set of comprehensive and informative MQs. BLM provided a preliminary set of 70 MQs in 19 groups. We refined these preliminary MQs using seven criteria.

(1) Is each MQ stated in a clear and focused way that can be commonly understood by all participants?

(2) Is each MQ matched to and answerable with available data and planned analyses?

(3) Are there important issues or questions missing from the list of MQs?

(4) Are there MQs that are extraneous, duplicative, or determined to be of lesser importance?

(5) Do any MQs suggest Conservation Elements or Change Agents that are missing from the target lists (under development) for the project?

(6) Are all Conservation Elements and Change Agents addressed in at least one MQ?

(7) Are each of the MQs clearly incorporated somewhere into the ecological models under development for the project?

Applying these criteria led to adjustments to the text and phrasing of the preliminary MQs and a small number of additions and deletions. Our complete set of MQs is based on the groundwork described in Memo I-1-a and the discussions of AMT1. The resulting list includes 87 MQs in 21 categories, cross-referenced with CEs and/or CAs.

Many important MQs are expressed as simple "Where" questions. They require minimal formal analysis and are typically geospatial descriptions of the locations of CEs, the presence of CAs, features such as aquatic resources, and other data entities or processes of interest. A useful land management analysis can result from overlaying the results of "Where" questions to identify areas of potential management concern. Such maps of potential effects do not demonstrate an existing impact or problem, but they can (1) help prioritize locations that warrant further investigation and (2) identify opportunities for high impact management action. Other MQs may be based on more complicated development of indices or projections into the future.

Collectively, the MQs are meant to create a picture of the overall health and integrity of the ecoregion, the threats to it, and point to locations of potentially effective and sustaining high-impact management actions.

Conservation *Elements*

Conservation Elements: A first step in most natural resource assessments is the identification of the features to provide a focus. We must ask and answer: ***What is it that we wish to evaluate and assess?*** For Rapid Ecoregional Assessments, we refer to these as “conservation elements” (CEs). Key to selection of conservation elements is establishing clarity of purpose. ***What do we need to learn from the assessment?*** For this REA, we propose a two-track focus for assessment. One track focuses on the ecological resources of the ecoregion, supporting regional biodiversity and providing the major ecosystem services. This focus emphasizes assessment of ecological integrity of landscapes and waterscapes. These define our **Core Conservation Elements.** The second track augments the first by including additional resource values of interest to agencies and stakeholders. These define our **Desired Conservation Elements.**

To define our core conservation elements we propose a “coarse filter/fine filter” approach, used extensively for regional and local landscape assessments since the 1970s. ‘Coarse-filter’ focal ecological resources typically include all of the major ecosystem types within the assessment landscape. We then pose the question; if all major ecosystem types are managed and conserved in sufficient area and landscape configuration, which of the ‘vulnerable’ species will have sufficient habitat “swept along”? Those species that are ***not*** adequately addressed through management of the coarse-filter elements are included as additional foci for assessment – the “fine filter.” This approach therefore sets up a multi-level strategy to define an effective focus for assessment.

Through analysis of existing information, we have established 22 upland, wetland, and aquatic ‘coarse filter’ units as on focus for assessment. We then evaluated available information on species of conservation concern, including criteria established by BLM in the Scope of Work. For species to be treated in this assessment, we proposed several selection criteria that were approved in AMT workshop 1, including:

a) All taxa listed under Federal or State protective legislation (*including species, subspecies, or designated subpopulations*)
b) Full species with NatureServe Global Conservation Status rank of G1-G3
c) Full species or subspecies listed as BLM Special Status and those listed by applicable SWAPs with habitat included within the ecoregion
d) Full species and subspecies scored as *Vulnerable* within the ecoregion according to the application of the NatureServe Climate Change Vulnerability Index (CCVI).

These criteria result in an initial listing of several hundred species. All species of potential interest to the assessment may therefore be viewed within this “coarse filter/fine filter” framework, establishing:

1) which species are likely to be adequately addressed through assessment of major ecological systems of the ecoregion (e.g., species strongly affiliated with desert springs).
2) which species might be represented as ecologically-based assemblages; i.e., groups of species that could be effectively treated together due to group behavior and similar habitat requirement, like bat hibernacula, migratory bird stopover sites, raptor nesting/foraging zones, etc.;
3) which should be best addressed as individuals in the assessment; and

4) which species will be treated primarily within subsequent sub-assessments

Once this list is finalized, conceptual ecological models (and in many cases, spatial models) will be developed for each to state assumptions about key ecological drivers and evaluate their location and condition over time across the ecoregion. Desired conservation elements follow those listed in the scope of work, and after subsequent discussion, their listing in this memorandum serves to document the current viewpoint of the Assessment Management Team.

Change Agents

Change agents (CAs) are those features or phenomena that have the potential to affect the size, condition and landscape context of conservation elements. CAs include broad regional agents that have landscape level impacts such as wildfire, invasive species, exotic ungulate grazing, climate change, and pollution as well as localized impacts such as development, infrastructure, and extractive energy development. CAs act differentially on individual CEs and for some CEs may have neutral or positive effects but in general are expected to cause negative impacts. CAs can impact CEs at the point of occurrence as well as offsite. CAs are also expected to act synergistically with other CAs to have increased or secondary effects. All change agents have been reviewed to determine potential impacts to conservation elements, if the impact is currently present, will remain present in the future, or is not present but considered a potential future impact. In this assessment we reviewed the list of proposed CAs from the AMT and consulted a variety of sources to:

1. Identify additional potential CAs and whether they are currently affecting the ecoregion, expected to in the future or both.
2. Characterize the ecological effects of the CA
3. Identify potential CEs that would be affected
4. Characterize potential CE impacts

Change Agent Key Recommendations

1. We found the list of candidate CAs provided by the AMT to be highly relevant and recommend inclusion of all for further assessment for data availability and quality. We also recommend adding alterations to surface water hydrology, as these changes strongly affect fish and other aquatic and riparian CEs. Our recommendation to include exotic ungulate grazing was approved but there is further guidance expected from BLM as to how it is characterized and assessed as a CA.
2. Atmospheric deposition was added in the Air and Water Quality category to address the impacts of acidification of soil, aquatic systems and root dynamics, nutrient enrichment, and mercury contamination.
3. Based on considerable input at the workshop, terrestrial invasive species recommended for assessment will include: Maltastar thistle (*Centaurea melitensis*), Russian thistle (*Salsola iberica*), cheatgrass (*Bromus tectorum*), filaree (*Erodium cicutarium*), red brome (*Bromus rubens*), split grass (*Schismus* spp.), tamarisk (*Tamarix ramosissima*), Saharan mustard (*Brassica tournefortii*), Crimson fountain grass (*Pennisetum setaceum*), Camelthorn (*Alhagi maurorum*), White top (*Lepidium latifolium*), Buffelgrass (*Pennisetum ciliare*), Weeping love grass (*Eragrostis curvula*), Date Palm (*Phoenix dactylifera*), Russian Knapweed (*Acroptilon repens*) and other knapweeds (*Centaurea* spp.). Additional species may be added during Phase II during data availability assessment of high priority invasive species listed by Arizona, California and Nevada weed lists (see the Change Agents: Terrestrial Invasive Species section for more detail).

Recommended Future Research

We anticipate most recommendations to be additive as we filter the CE and CA candidates through the following data assessment and proposed modeling tasks with AMT review and input. Several items are likely to drop out as infeasible in the REA. In this Task we identified the following recommendations for future research outside of this REA:

1. Assess BLM's process and capacity for conducting inventory and monitoring of CEs and CAs across the ecoregion.
2. A considerable breadth of empirical research is likely needed to understand the effects of particular CAs on specific CEs. As we move through the model development and assessment phases, these needs will be better articulated.
3. Some highly specific soil vulnerability assessments were suggested that would require subsequent research to address.

Task 1 Refine Management Questions and Select Conservation Elements

Introduction

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<u>Introduction to Memorandum I-a</u>

This memorandum summarizes our assessment and recommendations for each component of the REA based on initial recommendations of the AMT and a rapid assessment from existing studies and contractor staff knowledge. The memorandum is organized according to the Task objectives above. Details are provided in tables in the appendices.

<u>Component Assessments and Recommendations</u>

I-1.1.1.Conceptual Ecoregion Model, Description, and Assessment Boundary

For Rapid Ecoregional Assessment, conceptual ecological models assist with organizing current knowledge and communicating key assumptions about the environmental controls and dynamics that characterize the regional landscape. Conceptual models commonly include 'box-and-arrow' diagrams, tabular summaries, and textual descriptions. Here, we follow current recommended approaches (e.g., Gross 2005) to organize a conceptual model for the ecoregion. We draw upon a wealth of existing descriptive information, including conceptual models developed for the National Park Service Inventory and Monitoring programs (Miller 2005, Chung-MacCoubrey et al. 2008), ecoregion descriptions of the NRCS (USDA NRCS 2006), US Forest Service (McNab et al. 2007) and the Mojave Desert Ecoregional Blueprint of The Nature Conservancy (Moore et al. 2001).

The purpose of this model is to articulate key assumptions about regional landscape pattern and process that will inform our selection and analysis of conservation elements and change agents. This overarching description and model will provide a framework for series of component models for the ecoregion.

First, to define the ***spatial bounds*** of our model – ***defining the assessment boundary for the REA -*** includes the extent of the Rapid Ecoregional Assessment includes the area within the boundary of ecoregion number 14, as originally defined by Omernik (1987) and EPA (2007) plus the area within a buffer surrounding the ecoregion (Figure 1). The buffer includes that area outside the ecoregion boundary comprised of those 5th-level, 10-digit hydrologic units that overlap the ecoregion boundary (per BLM REA standards). With the buffer area, the extent will have a total area of 63,377 miles^2 (164, 146 km^2). This buffer may be revisited during later Tasks to ensure it is adequate to capture important CA effects coming into the ecoregion.

The Mojave Basin and Range lies to the immediate east of the Sierra Nevada and Southern and Baja California Pine Oak Mountains, to the north of the Sonoran Desert, to the west of the Arizona/New Mexico Plateau and a small portion of the Colorado Plateau ecoregions. It is largely defined within the Forest Service's American Semidesert and Desert Province and is mainly defined as the 322A-Mojave Desert Section (McNab et al. 2007) and the Mojave Desert MRLA with the Western Range and Irrigated Region of NRCS (USDA NRCS 2006). It falls into the North American Warm Desert EcoDivision as defined by NatureServe (Comer et al. 2003). The Mojave Basin and Range ecoregion itself is defined quite closely to the Mojave Desert ecoregion, as defined and used by The Nature Conservancy (Moore et al. 2001).

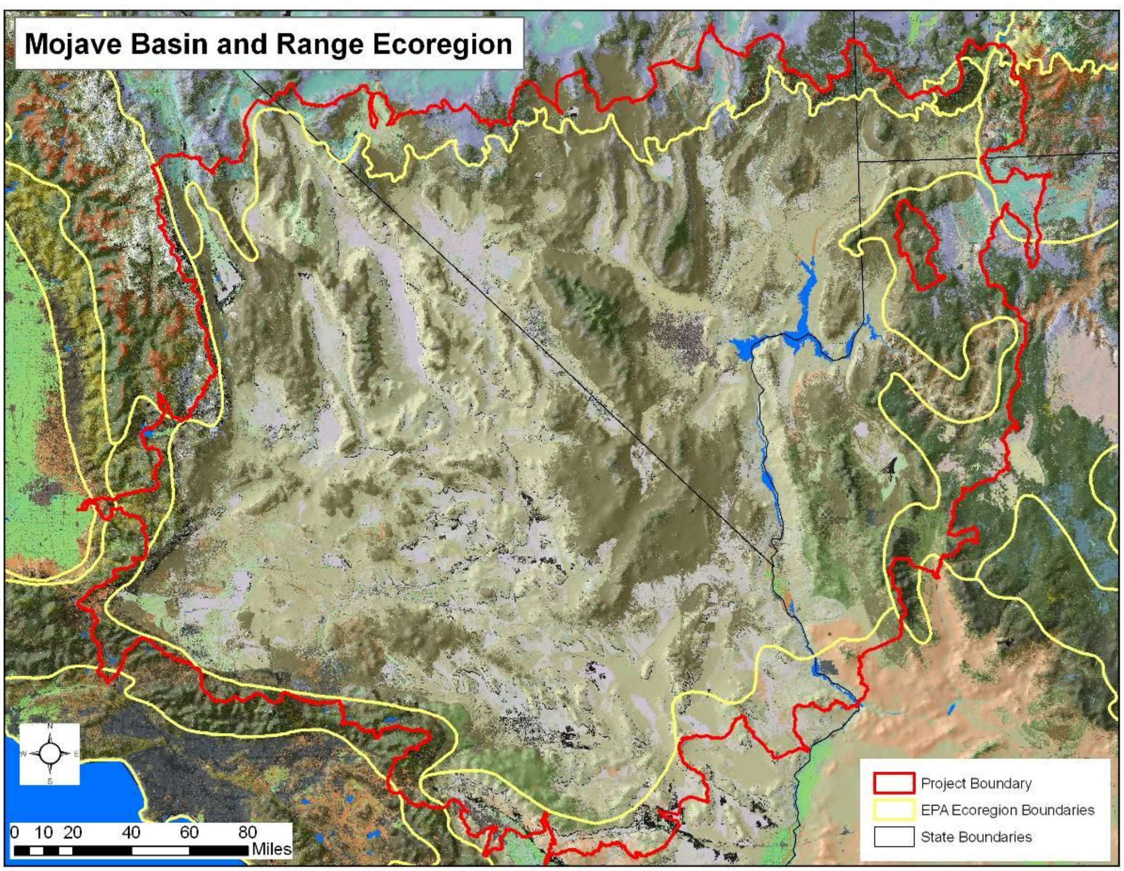

Figure 1. Boundaries for the Mojave Basin and Range Ecoregion.

As noted in EPA (2007), "This ecoregion contains broad basins and scattered mountains that are generally lower, warmer, and drier, than those of the Central Basin and Range (13). Its creosote bush-dominated shrub community is distinct from the saltbush–greasewood and sagebrush–grass associations that occur to the north in the Central Basin and Range (13) and Northern Basin and Range (80); it is also differs from the paloverde–cactus shrub and saguaro cactus that occur in the Sonoran Basin and Range (81) to the south. Most of this region is federally owned and exotic ungulate grazing is constrained by the lack of water and forage for livestock. Heavy use of off-road vehicles and motorcycles in some areas has made the soils susceptible to wind and water erosion."

The ecological boundary of the Mojave Basin and Range is more readily distinguished by fairly sharp vegetation changes along its western and eastern edges, with abrupt transitions into high-plateau and montane environments. As noted in the EPA ecoregion description, the transitions are less abrupt along the southern borders, as warm desert transitions into an abundance of succulents across the Sonoran Desert. The northern transition into the Central Basin and Range is more subtle, as salt desert scrub, blackbrush, and sagebrush vegetation dominates much of that transition.

The ***temporal bounds*** of this conceptual model would include the past two centuries, but center on the 20th century and decade of 2001-2011. This time period reflects the climatic regimes, ecological patterns and processes, and change agents that are most applicable to this assessment. Our assessment will look to future time periods for evaluation of climate-induced stress and land use scenarios, but for conceptual modeling, our initial set of assumptions lead up to today.

Biophysical Controls

Regional Physiography: Between the Sierra Nevada, Tehachapi, San Gabriel, and San Bernadino ranges to the west and Virgin Mountains and Black Mountains to the east, broad valleys, basins and old lake beds dominate the ecoregion, interspersed with scattered mountains, generally trending north-to-south (USDA NRCS, 2006). The isolated, low mountains are fault blocks, generally tilted up, and separated by aggraded desert plains. Most mountains are underlain by pre-Cenozoic metamorphic and igneous rocks, Paleozoic carbonates (e.g., limestones), non-marine sediments and volcanic deposits. Deposits of silver, gold, and talc are associated with areas where granitic magma intruded through sedimentary rocks. Recent tectonic activity is associated with volcanic activity and seismicity throughout the ecoregion, but especially along the western side (e.g., the Eastern California Shear Zone). Long alluvial fans trend into dry lake beds or playas on many valley floors. Alluvial fans date from late Pleistocene and throughout the Holocene, and include a gradation from boulder-strewn plains, coarse-textured pavements, on to finer grains sand, silts, and clays. Intermittent flooding and evaporation leave mineral deposits across playa surfaces, including salts and borates. Elevations in the Mojave Basin and Range vary from 85 m 282 ft) below sea level, within the Badwater Basin of Death Valley, to up above 3,385 m (11,100 ft) in the Spring and Panamint ranges. As defined by four-digit hydrologic units, major watersheds include the Northern Mojave-Mono Lake, the Lower Colorado-Lake Mead, the Southern Mojave-Salton Sea, Central Nevada Desert Basins, and Lower Colorado units. The Colorado River crosses the southeast end of the ecoregion. Other major rivers include the Armagosa and Mojave rivers (USDA NRCS, 2006).

Regional Climate Regime: Due to its location in the rain shadow of major mountain ranges, the climate of the Mojave Basin and Range is quite arid. Death Valley is considered one of the hottest and driest places in the Western Hemisphere, with an average annual precipitation of 1.96 inches (0.5 cm) and summer high temperatures of 134° F (56.7° C) (USDA NRCS, 2006). Ecoregion-wide, average annual precipitation is 2-8 inches (50-205mm). Most rainfall occurs during winter months, with low-intensity rainfall from Pacific storms. There is also a limited Mediterranean influence (winter precipitation and pronounced dry summers) as defined through some bioclimatic classifications (Sayre et al. 2009; Cress et al. 2009). While occasional high-intensity rainfall occurs during the summer, it is thought to contribute little to soil moisture, given intense evaporation. Snow is uncommon in lower elevations, but among the mountain ranges, average annual snowfall reaches 30 inches (760 mm). Average annual temperatures vary from 43° F (6° C) in the higher mountains to 76° F (25° C) along the Colorado River. Between mountains and valley bottoms, frost-free periods vary from 160-365 days per year, respectively.

Major Systems for Conceptual Modeling

Here we adapt existing model concepts developed by Chung-MacCoubrey et al. (2008), recognizing climatic and regional physiographic pattern. These influences of climatic regimes interacting with the basin and range physiography provide overarching biophysical controls on nested systems. Affected in part by variation in solar radiation and air density, seasonal temperature regimes vary along longitudinal, latitudinal, and elevational gradients. Seasonal precipitation regimes vary along these gradients, but also are affected by rain-shadow effects from mountain ranges. Combined, these controlling regimes set up regional patterns in wind, dry/wet atmospheric deposition, and air quality (e.g., visibility).

We then define the major model components (Figure 2); acknowledging the central role of water in this desert ecoregion, we first distinguish upland 'dry-land' ecosystems driven generally by water scarcity from aquatic, riparian, and wetland ecosystems driven by water flow regimes. Given the pervasive influence of interacting climate and physiography, we distinguish the major model components into "Montane Dry Land" vs. "Basin Dry Land" and "Montane Wet" vs. "Basin Wet" systems. The dry land systems include natural drivers of soil moisture infiltration, erosion, soil organic matter accumulation, and natural disturbance dynamics such as windthrow and wildfire. These vary considerably between higher, cooler montane settings and warmer basin settings. Likewise, "wet" systems, including streams, larger rivers, lakes, springs, desert sinks, wetlands, and riparian environments, are strongly driven by seasonal water flow regimes and the relative influence of surface to groundwater dynamics. Montane wet systems are most strongly driven by surface water flow regimes, while those within the basins combine surface flow dynamics with groundwater flows and evaporation. All of these natural abiotic drivers constrain and influence biotic responses, such as predator/prey dynamics, herbivory, etc.

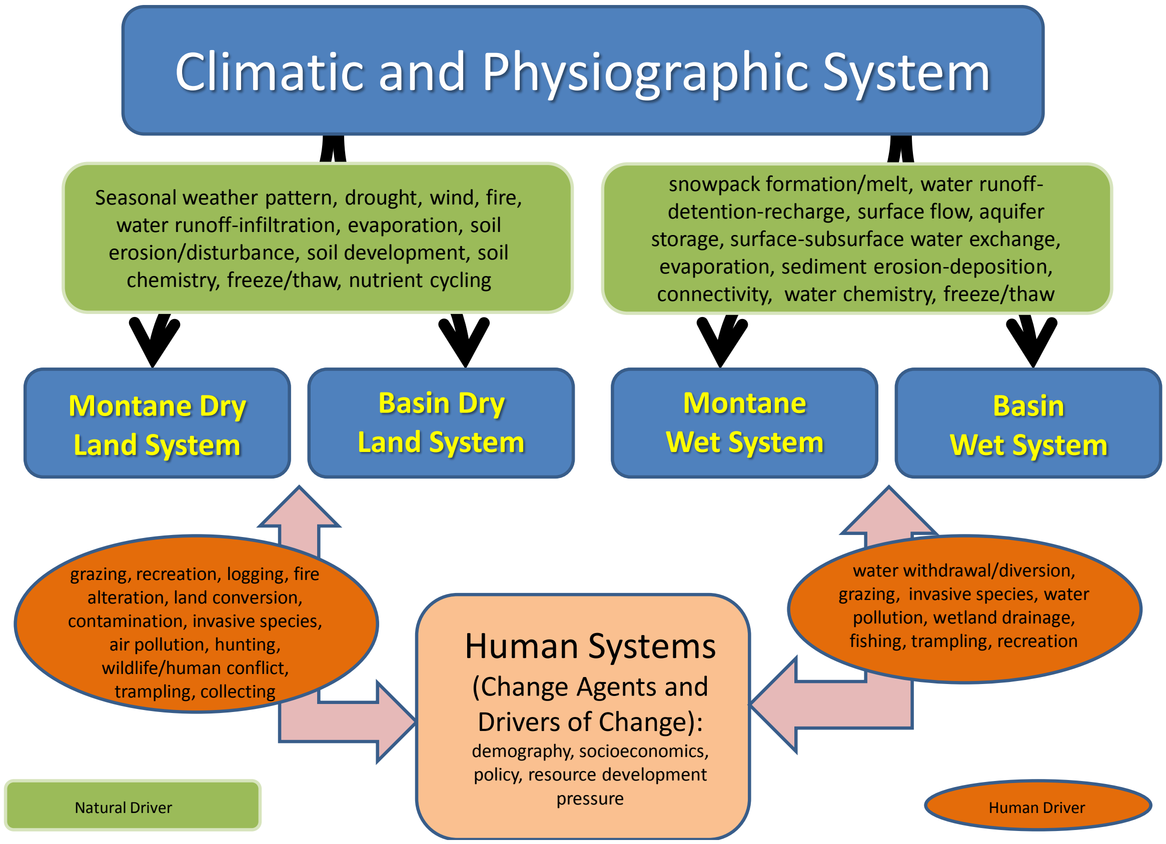

Figure 2. Conceptual Model for the Mojave Basin and Range Ecoregion.

The human dimension enters as a distinct component model, as socioeconomic and demographic drivers of change in land and water use and policy overlay on other model components. While there are many positive interactions (e.g., economic development, outdoor recreation, and solitude), we see natural drivers such as herbivory, wildfire, and biotic soil crust processes directly altered through exotic ungulate grazing regimes and altered fire regimes in the dry land systems. Predator/prey dynamics are influenced by human/wildlife conflicts, hunting, exotic ungulate (e.g. horse/burro) congregation, and collecting. Land conversion and introduction of invasive plant species closely follow human land use patterns for settlements, energy development (e.g., mining, oil/gas, solar, wind farms, geothermal), irrigated agriculture, or transportation/communication infrastructure. Within wet systems, the human dimension appears through water withdrawals or diversions, water pollution, wetland alterations through hydrologic alteration, conversion, exotic ungulate trampling, or introduction of invasive species.

Subsystem models follow from these four broad components. Here we tentatively define categories for regional submodels that will provide organizational cohesion to subsequent assessment. Within each of these component models, we introduce additional detail, organizing natural drivers in terms of "slow physical drivers," such as landscape or soil properties and processes that change on decadal timeframes, vs. "fast physical drivers," such as wildfire and flooding regimes, that occur over very short time frames. Here we also then differentiate the biotic drivers, including the responses and interactions of biota within stated physical bounds and regimes.

The Montane Dry Land System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for high-elevation forests and woodlands, pinyon-juniper woodlands, high desert chaparrals, and montane cliff and canyon environments.

Encompassing the vast majority of the ecoregion, the Basin Dry Land System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for semi-desert shrublands, desert grasslands, desert scrubs, desert badlands, pavements, cliff, rock outcrops, and sand dunes (Figure 3).

The Montane Wet System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for the relatively limited subalpine-to-montane streams, wetlands, and riparian communities.

The Basin Wet System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for low-elevation rivers, streams, desert springs, Fan Palm Oases, marshes, and riparian communities, desert washes, playa lakes. These component models are depicted in Figure 4 and Figure 5.

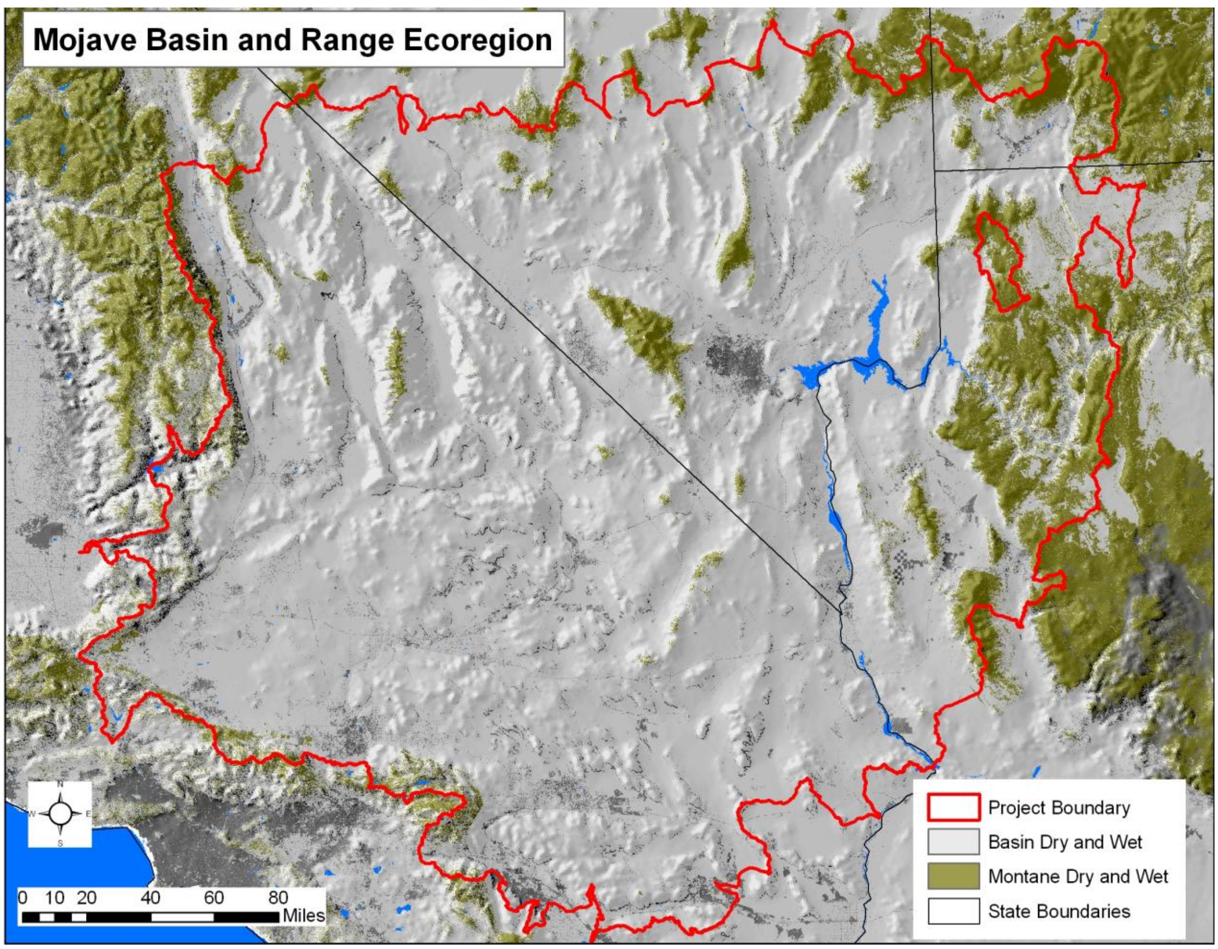

Figure 3. Spatial Distribution of Model Components for the Mojave Basin and Range ecoregion.

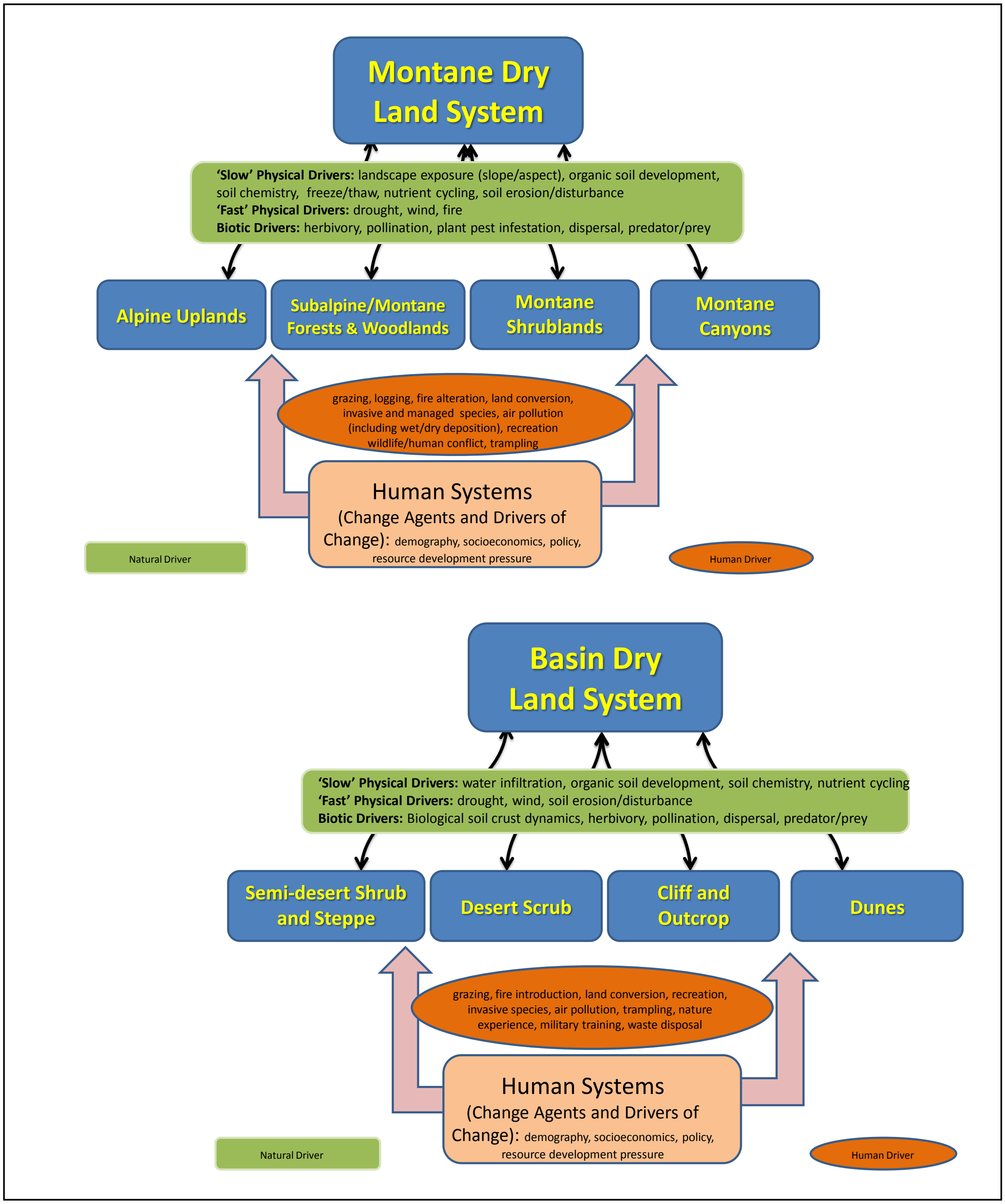

Figure 4. Dry Land Model Components for the Mojave Basin and Range ecoregion.

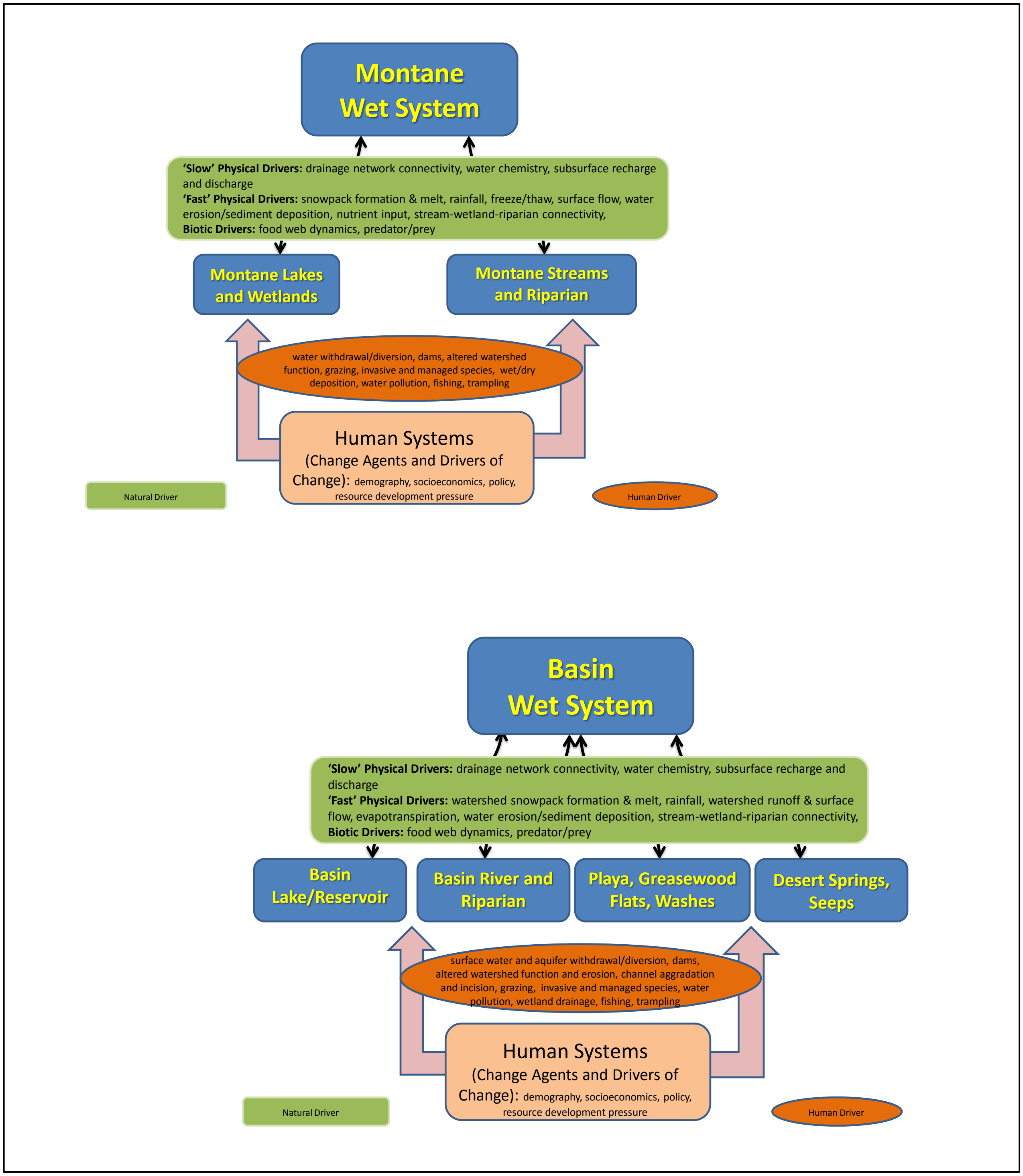

Figure 5. Aquatic Model Components for the Mojave Basin and Range ecoregion.

Sub-regionalization of the Mojave Basin and Range Ecoregion

Regional variation in controlling environmental factors affects relative distributions of conservation elements and relative concentrations of many change agents. Given this, some have devised ways to characterize the ecologically-based subdivisions of this regional landscape (e.g., Moore et al. 2001;

McNab et al. 2007). This sub-regionalization may provide a useful tool for organizing analysis, documenting conditions, and reporting on management alternatives.

Given the need to adequately consider both terrestrial and aquatic conservation elements and resources, we recommend careful consideration of options that take these two fundamental aspects of ecological pattern and process into account. In review of existing subregionalizations, we recommend consideration – and potential modification - as they apply to this ecoregion. These subregional units can provide for useful segmentation of the ecoregion from the perspective of terrestrial and aquatic ecosystems. **The AMT agreed to use of these concepts and NatureServe will develop a set of terrestrial subregional units for the ecoregion. As these units are defined, they will be shared with the AMT.** Subsequent conceptual and spatial models for a given conservation element and change agent might vary across these subregions, to better reflect local circumstances.

I-1.1.2.Management Questions

Individual Management Questions (MQs) address specific needs for information that will ultimately inform management actions on the landscape. Individual MQs are driven by an iterative dialog among three aspects of land management planning: (1) an understanding of the ecological systems and social context (which are embodied in the conceptual ecological models), (2) the entities that are of concern and are under management (i.e., Conservation Elements or other entities of interest), and (3) the processes or activities that can effect change in the managed landscape (i.e., Change Agents). Collectively, the set of MQs "roll up" to create understanding about status and trends in the landscape and identify threats. Importantly, the collection of MQs can also identify the landscape's ecological integrity, its resilience, and opportunities for constructive and effective management.

Box 1. Groups of Management Questions, followed by the number of questions in the group (in parenthesis). There are 87 MQs in 21 groups.

- Species (9)
- Native Plant Communities (4)
- Terrestrial Sites of High Biodiversity (3)
- Aquatic Sites of High Biodiversity (3)
- Specially Designated Areas of Ecological Value (1)
- Grazing, Wild Horses and Burros (7)
- Soils (3)
- Surface and Subsurface Water Availability (6)
- Aquatic Ecological Function and Structure (2)
- Fire History (2)
- Fire Potential (2)
- Invasive Species (5)
- Urban and Roads Development (5)
- Oil, Gas, and Mining Development (6)
- Renewable Energy Development (4)
- Groundwater Extraction and Transportation (5)
- Surface Water Consumption and Diversion (5)
- Climate Change: Terrestrial Resource Issues (6)
- Climate Change: Aquatic Resource Issues (5)
- Military Constrained Areas (3)
- Atmospheric Deposition (1)

A goal of Task 1 is to develop a set of strong and virtually MQs. Continued adjustments to the questions will be made throughout Phase 1 of the work, but Task 1 and the discussions during Assessment Management Team Workshop 1a (AMT1) will produce a strong penultimate set of questions. BLM provided a preliminary set of 70 MQs in 19 groups. We refined the MQs using seven criteria.

(1) Is each MQ stated in a clear and focused way that can be commonly understood by all participants?

(2) Is each MQ matched to and answerable with available data and planned analyses?

(3) Are there important issues or questions missing from the list of MQs?

(4) Are there MQs that are extraneous, duplicative, or determined to be of lesser importance?

(5) Do any MQs suggest Conservation Elements or Change Agents that are missing from the target lists (under development) for the project?

(6) Are all Conservation Elements and Change Agents addressed in at least one MQ?

(7) Are each of the MQs clearly incorporated somewhere into the ecological models under development for the project?

Applying these criteria led to adjustments to the text and phrasing of proposed adjustments MQs and a small number of additions and deletions. These proposals and their rationale were presented in Memo I-1-a and further discussed during AMT1. The increased clarity concerning BLM's needs for information and the precise meaning of terms resulted in the penultimate set of MQs presented here.

Note that we refer to this set of MQs as "penultimate" because additional modifications to MQs are likely throughout Phase 1 of the REA. For example, Task 2 investigates the availability of data to address each question (see criterion #2); Task 3 creates a set of detailed conceptual models for CEs (criterion #7) that may determine the final working definitions of terms that affect analysis. The original set of MQs provided by BLM is not included in this document, but can be reviewed in Memo I-1-a (App. 1).

Our complete proposed set of MQs can be found in App. 1 and is based on the groundwork described in Memo I-1-a and the discussions of AMT1. The resulting list includes 87 MQs in 21 categories. Each of the MQs listed in App. 1 is cross-referenced with CEs and/or CAs to which it pertains. There is also a "Notes" field that describes any outstanding issues that require resolution (such as definitions of terms that will be clarified during the conceptual modeling period, Task 3).

We note that the preliminary MQs for the Central Basin & Range and the Mojave Basin & Range were broadly similar, and in many cases identical. Discussions at AMT1 further reduced distinctions between the sets of questions. Although the lists for the two ecoregions are still not identical (due to ecological subtleties and small differences in needs for information), wherever the questions clearly addressed the same issue we have standardized the wording of the MQ. This will facilitate analysis and reduce confusion when comparing results across ecoregional boundaries.

Box 2. Major Classes of "Where" Questions

- Where are (or what is the distribution of) CEs, features, and processes of importance (species, native communities, biodiversity sites, refugia, aquatic communities)? [Applied to all CEs.]
- Where are critical habitats or landscape features (e.g., water bodies, ecological connectivity, restoration areas, protected areas)?
- Where are locations of action by Change Agents (both ecological and anthropogenic)? [Applied to all CAs.]

Studying the simple geographic overlap among these classes of questions identifies:

(1) areas that may experience the most significant ecological change, and;

(2) opportunities for high impact management action.

<u>"Where" Questions</u>: Although there are 21 substantive categories of MQs in Box 1 (e.g., "Species," "Native Plant Communities," "Climate Change: Terrestrial Issues," etc), many important MQs are expressed as simple "Where" questions based on existing data. There are such "Where" questions in every category of questions. For example, where are certain species of Spring Snails found? Where are surface water features? They require minimal formal analysis and are typically simply geospatial descriptions of the locations of CEs, the presence of CAs, features such as aquatic resources, and other data entities or processes of interest. General examples of such important "Where" questions are shown in Box 2. Note that "Where" questions repeat themselves throughout the complete list of MQs in App. 1, and across all of the groups.

A powerful land management analysis can result from overlaying the results of "Where" questions to identify areas of potential management concern. For example, a simple overlay of the distribution of each CE and each relevant CA produces, for each CE, a map of potential impacts from each CA. Of course, such a map of potential effects does not demonstrate an existing impact or problem, but (1) can help prioritize locations that warrant further investigation and (2) identify opportunities for high impact management action.

Other MQs may be based on more complicated development of indices or projections into the future. For example, Climate Change analyses require the melding of climate projections with understanding of how ecological processes and climate correlate. In some cases the precise wording of such MQs may not be resolved until near the end of Phase I. However, MQs that make predictions of future states and trends will be a critical part of the REA.

Box 3. Emergent or "Roll Up" Management Questions that Concern Integrity and Resilience

- What qualities or attributes of the ecoregion contribute (positively or negatively) to the ability of the ecoregion's ecological systems to resist or respond to disturbance and change?
- How are these qualities distributed across the ecoregion?
- How might their distribution be affected by climate change, development, and other change agents?
- Where are opportunities for effective ecological management?

Emergent Management Questions: Collectively, the MQs are meant to create a picture of the overall health and integrity of the ecoregion, the threats to it, and point to locations of potentially effective and sustaining high-impact management actions (Box 3). The exact nature of such emergent questions will clarify and evolve as analyses are accomplished.

Additional AMT Management Question recommendations

The following written recommendations were provided followed by our response for how these will be addressed:

- Soils as a CE
    - Where are soil blow out areas or areas of high wind erosion/dust/dunes likely to develop due to changes in climate (changes in vegetation cover)
    - Where are soil blow out areas (areas of high wind erosion/dust/dunes) likely to develop due to groundwater withdrawals or changes in water tables?
    - Where are soils that have greater susceptibility to impacts and/or are difficult to reclaim if disturbed?
    - Where are intact cryptogamic crusts located"
    - Where are areas that biological soil crusts are most likely to play a critical role in soil stabilization?
        - General response to all of the above suggestions is that these generally fall under the established MQs for soils from the original SOW:

Initial soils management questions:

- *Where are the areas of high susceptibility of soil erosion from wind erosion?*
- *What/where is the potential for future change in conditions, such as due to climate change?*
    - Questions more specific than those already established will have further consideration through Phase 1 Task 3 but are likely to be answered in the more general way due to lack of more specific data or scientific knowledge or resources to expand the scope to directly address them.

I-1.1.3. Conservation Elements (CEs)

Introduction

A first step in most natural resource assessments is the identification of the features to provide a focus (Margules and Pressey 2000, Groves et al. 2002, Stoms et al. 2005). We must ask and answer: ***What is it that we wish to evaluate and assess?*** For Rapid Ecoregional Assessments, we refer to these as "conservation elements." These elements could include habitat or populations for plant and animal taxa, such as threatened and endangered species, or ecological systems and plant communities of local interest. A list of conservation elements could also include other resource values, such as highly erodible soils, populations of wild horses and burros, scenic viewsheds, or already designated sites of natural, historical or cultural significance.

Key to selection of conservation elements is establishing clarity of purpose. ***What do we need to learn from the assessment?*** For this REA, we propose a two-track focus for assessment. One track focuses on the ecological resources of the ecoregion, supporting regional biodiversity and providing the major ecosystems services. This track emphasizes assessment of ecological integrity of landscapes and waterscapes (*sensu* Parrish et al. 2002, Unnasch et al. 2008). These define our **Core Conservation Elements.** The second track augments the first by including additional resource values of interest to agencies and stakeholders. These define our **Desired Conservation Elements.**

For our first track, we encounter the dilemma of selecting an efficient list of elements that will help us to adequately address the complexity of natural ecosystems. We seek an effective focus to articulate our assumptions about key ecological drivers of natural systems. If we can do this, we will then seek to effectively gauge the relative effects of change agents on these important natural resources. Our dilemma is that we cannot practically take a 'species by species' approach, hoping to account for all aspects of their individual life histories. Many thousands of species, from large-bodied carnivores, to vascular and non-vascular plants, to soil microbes occur across each ecoregion, precluding this approach. We are *always* forced to select some type of 'surrogate' to represent whole suites of species and the main ecological processes that define a given landscape.

We proposed, and the AMT agreed, to take a "coarse filter/fine filter" approach, was originally proposed by scientists from The Nature Conservancy (Jenkins 1976, Noss 1987, Hunter 1990) and used extensively for regional and local landscape assessments (Moore et al. 2001, Noss et al. 2002, etc.). It focuses primarily on ecosystem representation, complimented by a limited subset of focal species assemblages and individual species. 'Coarse-filter' focal ecological resources are identified first, and typically include all of the major ecosystem types within the assessment landscape. The intent of this focus is to represent all of the predominant natural ecosystem functions and services in the ecoregion. Researchers and managers then consider whether individual species of concern - those that are in some way 'vulnerable' to being lost - have habitat requirements that are adequately represented by the coarse filter units. That is, we pose the question; if all major ecosystem types are managed and conserved in sufficient area and landscape configuration, which of the 'vulnerable' species will have sufficient habitat "swept along"? Those species that are ***not*** adequately addressed through ecosystem-scale conservation are included as additional foci for assessment – the "fine filter." This approach therefore sets up a multi-level approach to define an effective focus for assessment.

Building from the framework of our ecoregional conceptual model, we first identified the major ecological systems for the ecoregion as one focus for assessment. All species of potential interest to the assessment may therefore be viewed within this "coarse filter/fine filter" framework, with specific criteria established for the selection and treatment (see below). Again, our intent is to provide an effective focus for assessment. Once this list is established, conceptual ecological models will be developed for each to state assumptions about key ecological drivers.

Selecting Core Conservation Elements

Our candidate lists reflect our proposal to apply a 'coarse filter/fine filter' approach to identify ecosystem, species assemblages, and individual species that collectively should aid in assessing ecological integrity across the regional landscape. From the established Scope of Work, this encompasses the listed Native Fish, Wildlife, or Plants of Conservation Concern, Regionally Important Terrestrial Ecological Features, Functions, and Services, and Regionally Important Aquatic Ecological Features, Functions and Services. We completed an initial analysis of NatureServe central databases and 'conservation target' lists from the Nature Conservancy ecoregional plans to identify species that meet BLM stated criteria for "Other Priority Wildlife (& Plant & Aquatic) Species;" as well as all federally listed species. This generated our initial master list of species of potential conservation concern for the ecoregion.

Coarse-Filter Elements

The "coarse filter" includes 22 terrestrial and aquatic ecological system types and communities that express the predominant ecological pattern and dynamics of the ecoregion (Table 1). These classified units a) characterize each component of the ecoregion's conceptual model, b) define the vast majority of this ecoregion's lands and waters, and c) reflect described ecological types with distributions concentrated within this ecoregion. By treating these in our assessment we aim to adequately treat the habitat requirements of most characteristic native species, ecological functions, and ecosystem services. Ecological models (both conceptual and spatial) for these coarse filter elements will form a major focus for this ecoregional assessment. NatureServe ecological classifications provided the basis for several existing national or regional map products (e.g., NatureServe national map, ReGAP in CA and SW region, LANDFIRE EVT & BpS, etc.) and/or may be readily reconciled with locally-desired classification systems for plant communities (see http://www.natureserve.org/explorer/ for more detailed descriptions of ecosystem types listed in Appendix 2). We used NatureServe databases and existing map products to establish our proposed list of these core CEs. Appendix 2 includes an annotated listing for each of the upland and wetland examples of these coarse filter units. Those that are entirely aquatic (e.g., reservoirs, etc.) have yet to be fully examined for their relationships to aquatic coarse filter CEs.

Table 1. Proposed Coarse-Filter Conservation Elements for Mojave Basin and Range Ecoregion.

Ecosystem Name	% of Ecoregion	Land Cover Class
Basin Dryland Ecosystems	**83.5%**	
Sonora-Mojave Creosotebush-White Bursage Desert Scrub*	33.8%	Short Shrubland
Mojave Mid-Elevation Mixed Desert Scrub	32.5%	Short Shrubland
North American Warm Desert Pavement	8.8%	Sparsely Vegetated
North American Warm Desert Bedrock Cliff and Outcrop	2.4%	Sparsely Vegetated
Sonoran Mid-Elevation Desert Scrub	2.2%	Short Shrubland
Sonora-Mojave Mixed Salt Desert Scrub	1.7%	Short Shrubland
North American Warm Desert Badland	1.0%	Sparsely Vegetated
Great Basin Xeric Mixed Sagebrush Shrubland	0.7%	Short Shrubland
North American Warm Desert Active and Stabilized Dune	0.2%	Sparsely Vegetated
Inter-Mountain Basins Mixed Salt Desert Scrub	0.1%	Short Shrubland

Ecosystem Name	**% of Ecoregion**	**Land Cover Class**
Basin Wet Ecosystems	**6.2%**	
North American Warm Desert Playa	4.5%	Sparsely Vegetated
North American Warm Desert Wash	1.5%	Short Shrubland
North American Warm Desert Riparian Woodland and Shrubland/Stream	0.2%	Woody Wetlands and Riparian
North American Warm Desert Riparian Mesquite Bosque	0.0%	Woody Wetlands and Riparian
North American Arid West Emergent Marsh/Pond	0.0%	Herbaceous Wetlands
Mojave Desert Springs and Seeps	0.0%	Aquatic
California Fan Palm Oasis	0.0%	Woody Wetland and Riparian
Reservoir	not estimated	Aquatic
Montane Dryland Ecosystems	**2.5%**	
Great Basin Pinyon-Juniper Woodland	1.9%	Evergreen Forest and Woodland
Mogollon Chaparral	0.5%	Tall Shrubland
Sonora-Mojave Semi-Desert Chaparral	0.2%	Tall Shrubland
Montane Wet Ecosystems	**0.0%**	
North American Warm Desert Lower Montane Riparian Woodland and Shrubland/Stream	0.0%	Woody Wetlands and Riparian

***those bolded were types referenced directly or indirectly in statement of work**

Fine-Filter Elements

Again, the “fine-filter” includes species that, due to their conservation status and/or specificity in their habitat requirements, are likely vulnerable to being impacted or lost from the ecoregion unless resource management is directed towards their particular needs. We propose to treat species falling within this general category into two subcategories; a) those that might be effectively treated as a species assemblage; i.e., their habitat and known populations co-occur sufficiently to treat them as a single unit of analysis, and b) those species to be treated individually.

For species to be treated in this assessment, we proposed, and the AMT accepted, several selection criteria for inclusion and treatment in the assessment. These criteria include:

a. All taxa listed under Federal or State protective legislation (including species, subspecies, or designated subpopulations)
b. Full species with NatureServe Global Conservation Status rank of G1-G3[1]
c. Full species or subspecies listed as BLM Special Status and those listed by applicable SWAPs with habitat included within the ecoregion
d. Full species and subspecies scored as *Vulnerable* within the ecoregion according to the NatureServe Climate Change Vulnerability Index (CCVI).

[1] See http://www.natureserve.org/explorer/ranking.htm for NatureServe Conseravtion Status Rank definitions

Appendix 4a includes a draft list for the ecoregion for species under criteria a-b above. Additional effort will now be undertaken to integrate existing information and confirm species that would meet criterion c) by reviewing state lists of BLM Special Status Species, and those listed under applicable SWAPs, to establish those species with habitat included within the ecoregion.

Criterion d) involves application of the NatureServe CCVI to candidate species that might otherwise NOT be included in the assessment, but for their resulting status under the CCVI. Specific selection criteria for the sub-analysis include:

1) Taxa listed of conservation concern in the Great Basin Ecoregional Assessment of The Nature Conservancy (Moore et al. 2001).
2) Full species with NatureServe Global Conservation Status rank of G3?-G3G4
3) Subspecies with NatureServe Status Rank of T1-T3

Appendix 4b includes a draft list for the ecoregion for species under criteria c-d above. Each of these categories should help to identify species that, while they have been of some limited conservation concern within the ecoregion, concern will likely increase within coming decades. Subsequent application of the CCVI would distinguish those of greater likelihood to the affected by climate-induced stress over coming decades, and be more likely to face further declines. Preventive management action to benefit these species would therefore be advisable.

Treating Core Conservation Elements in the Assessment

As previously stated, a "coarse filter/fine filter approach" intends to provide an effective focus for assessment. This applies both to criteria for selection of component elements, and to the various means of their treatment for analysis. Representative ecological types, as listed in Table 1 form our initial focus of assessment, and will be treated through mapping, modeling, and various assessment methods. We then proposed and established several distinct approaches to treating species that meet established criteria for inclusion in the REA. These include:

- Species assumed to be adequately ***represented indirectly through the assessment of major "coarse-filter"*** ecological systems of the ecoregion. For example, species strongly affiliated with desert springs may be adequately treated in the REA through assessment of desert springs themselves.
- Species assumed to be adequately ***represented indirectly as ecologically-based assemblages***. That is, due to group behavior and similar habitat requirement, a recognizable species assemblage is defined and treated as the unit of analysis. Examples could include bat hibernacula, treating multiple species of bats; all or some of whom are of conservation concern. Similarly, migratory bird stopover sites or raptor nesting/foraging zones could also be treated as multi-species assemblages.
- Species which should be ***best addressed as individuals*** in the assessment. These include those species meeting our criteria for assessment that cannot be presumed to be included in the previous two categories. This will tend to include many major 'landscape' species that range over wide areas within the ecoregion and with clearly distinct habitat requirements from all other taxa of concern.

Finally, for species of concern from the latter category that have ***very narrow distributions; limited to one BLM management jurisdiction,*** we will gather current locational information, but will not aim to develop conceptual models for these elements. We will continue to work with the AMT to determine appropriate means to spatially represent these elements e.g., as concentration zones of CEs, etc. Otherwise, these elements will be treated within sub-assessments subsequent to the REA. Appendix 4 provides a summary listing of candidate species for this REA. Subsequent efforts by our team, securing input from other regional botanists and wildlife ecologists, will finalize the selection and treatment of species within this REA.

As one preliminary step towards this refinement phase, we then completed a preliminary analysis of approximately 15,000 locality records for species of potential conservation concern, combining known localities with current maps of terrestrial ecological systems. This enabled an initial exploration and identification of habitat-based species assemblages for treatment in this assessment. Appendix 5 includes a list of upland species that might be adequately addressed in the assessment via analysis of 'coarse filter' ecological systems. Of the known localities for these species, 50-100% coincide with one ecological system type. A similar analysis is in progress for aquatic species (Appendix 6). We believe these species respond sufficiently closely to the prevailing ecological processes supporting each coarse-filter ecological system type, that for purposes of this assessment, this would be the most effective approach. Again, we will complete additional expert analysis of these species to finalize habitat-based listings for species of concern.

Proposed Desired Conservation Elements

We intend to include a limited set of soil types of conservation concern (e.g., Gypsum soils, Highly erodible soils) in the assessment. Subsequent interaction with the AMT will clarify whether this treatment is desired and/or to provide additional elements to this list. We recommended, and the AMT agreed, to gather locational information on Areas High Biodiversity Significance, Specially Designated Areas of Ecological Value. However, these need not be treated as conservation elements. They may be effectively categorized as "reporting units." Assessment reporting can be completed with respect to these features without treating them directly as conservation elements.

Summary of Recommendations for Conservation Elements

Table 4 includes a concise summary by category of conservation elements that we propose for this ecoregional assessment. A master list of candidate species elements for the ecoregion, including additional descriptive attributes, is found in Appendix 4.

Table 2. Summary of Proposed Conservation Elements for Mojave Ecoregion

Conservation Element Category	**Number of Elements**
Basin Dryland Ecosystems	10
Basin Wet Ecosystems	8
Montane Dryland Ecosystems	3
Montane Wet Ecosystems	1
Terrestrial Habitats with Nested Species Assemblages	~8
Aquatic Habitats with Nested Species Assemblages	~5
Species (overall candidate list)	
Plants	328
Animals	384
Desired Conservation Elements	
Soils of Conservation Concern	

I-1.1.4. Change agents (CAs)

Introduction

Change agents are those features or phenomena that have the potential to affect the size, condition and landscape context of conservation elements. CAs include broad regional agents that have landscape level impacts such as wildfire, invasive species, exotic ungulate grazing, climate change, and pollution as well as localized impacts such as development, infrastructure, and extractive energy development. CAs act differentially on individual CEs and for some CEs may have neutral or positive effects but in general are expected to cause negative impacts. CAs can impact CEs at the point of occurrence as well as offsite. CAs are also expected to act synergistically with other CAs to have increased or secondary effects. All change agents have been reviewed to determine potential impacts to conservation elements, if the impact is currently present, will remain present in the future, or is not present, but considered a future impact. In this assessment we reviewed the list of proposed CAs from the AMT and consulted a variety of sources to:

1. Identify additional potential CAs and whether they are currently affecting the ecoregion, expected to in the future or both.
2. Characterize the ecological effects of the CA
3. Identify potential CEs that would be affected
4. Characterize potential CE impacts

Change Agent Classes

Below we characterize the four classes of change agents and their major subclasses. Each class and subclass is given more detailed treatment in Appendix 2

<u>Class I Wildland Fire</u>

Increased and decreased fire frequency and intensity of the expected natural fire regimes can significantly alter vegetation structure and composition, leading to habitat degradation among CEs and increased risk of uncontrollable wildfire events. Increased fire frequency is considered a synergistic CA where disturbances such as exotic ungulate grazing and recreation contribute to the proliferation of exotic annual grasses therefore increasing fuel continuity, fire frequency and intensity. Decreased fire frequency has resulted from controlled fire suppression resulting in therefore increased fuel continuity and invasion of shrub communities by Pinyon and Juniper (Wisdom et al. 2003). Part of the assessment will include an evaluation (review and refinement) of fire models from Landfire (EVT and BPS), SageMap, SWRegap with current vegetation maps to determine, for example, current fire frequency and intensity (=severity as recommended in written comments) against historic data. Additional analyses will be conducted as determined by refinement of management questions.

<u>Class II Development</u>

This class contains a broad variety of CAs with very different CE effects; we therefore describe subclasses below. Some subclasses may likely be further divided for assessment (e.g., low density exurban development vs. dense urban):

- Urbanization: The Mohave ecoregion is growing very rapidly. The three fastest growing state-level populations in the country from 2000 to 2009 were Nevada (32%), Arizona (28%), and Utah (24%). Among the 100 fastest growing counties in the US are Washington, UT; Riverside, CA, and Nye, NV. Much of the growth in these areas is centered around North Las Vegas, NV (3rd fastest growing city 2000 to 2009 at 94.2%) and Henderson, NV (growing at 46.1%); and Victorville, CA (73.2% growth rate). Typically, the rapid population growth rate also means a concomitant rate of urbanization, or expansion of the urban footprint. In fact, the extent of urban or built-up land cover increased by over 76% in NV from 1997 to 2007 (NRCS 2007) to cover 582,000 acres – roughly twice the rate of population growth! Urbanization also expanded faster than population in Arizona (44%; 2,006,000 ac), and was even with population growth rate in Utah (23.7%; 744,000 ac). While the current economic situation has put the brakes on urbanization generally, these areas can be expected to return to rapid growth as the economy improves.

- Infrastructure (roads, pipelines, transmission lines, water transmission): Infrastructure development results in the partial to complete removal or destruction of vegetation and wildlife habitat within and adjacent to corridors, habitat fragmentation, retardation of habitat recovery due to maintenance, restricted gene flow, construction of features causing bird collision & altered predator behavior (e.g., introducing perches in non-forest lands for raptors), corridor expansion for non-native species, and extensive trenching and construction of hydrologic diversion structures. Effects of infrastructure development on aquatic CEs include such things as increased drainage basin networks, channelized flow, and increased sedimentation to local streams and springs. Following the urbanization component we anticipate urbanization-caused road expansion as well as energy and resources transmission changes (J. E. Lovich and D. Bainbridge 1999; Vasek et al. 1975; Nicholson 1978; Garlandand Bradley 1984; Boarman and Sazaki 1996; Jennings 1991; Rosen and Lowe 1994; Boarman and Sazaki 1996; Wilshire and Prose 1987; Zink et al. 1995). Infrastructure and urbanization operate synergistically with new roads opening up areas for development and increased urbanization driving the need for increased infrastructure.
- Energy development: We describe extractive vs. renewable energy types separately below
  - Renewable energy development (wind, solar, geothermal & biomass): In the short term, the Mojave Basin is poised to receive large renewable energy projects under the Fast-Track Renewable Energy Program (BLM, 2010). These projects and subsequent projects will take advantage of the region's abundant wind, solar and geothermal potential. These developments will destroy or alter habitat at-site as well as require new roads and transmission corridors to support them. Wind turbines impacts on birds (mortality, alteration of habitat use) have been documented but the effects vary greatly according to the sighting of the facility and type of technology used (Barrios & Rodriguez, 2004; Drewitt & Langston, 2006). Some older facilities have high mortality rates (Orloff & Flannery, 1992) while many newer facilities have very low mortality rates (Osborn et al, 2000). Some researchers have speculated that solar thermoelectric facilities (STF) may negatively impact insects and birds which inadvertently fly into high temperature areas (Mihlmester et al. 1980). Some proposed STF may use water drawn from desert aquifers which also creates concern (Beamish 2009). Biomass potential is low in the Mojave Basin and it is not expected to be a CA in the region.
  - Extractive energy development (oil, gas): This CA impacts CEs by destroying or altering habitat, creating bird collision features, introducing invasives, causing ground water pollution and volume changes, and creating movement barriers.
- Hydrologic Alterations: Ground and surface water withdrawals and altered surface flow pose significant threats to aquatic CEs in the ecoregion and generally can impact all species requiring free sources of freshwater in this highly arid region. Ground water withdrawals resulting from development and energy extraction reduce extent of perennial stream flows (gaining stream reaches), increase extent of dry streambeds (losing stream reaches), lower water levels and alter hydrologic regime of springs and seeps; and alter alluvial soil moisture regimes in riparian zones. Altered surface flows caused by barriers (dams, impoundments) inhibit the movement of aquatic fauna and transport of riparian plant propagules, can reduce ability of streams to recolonize reaches following disturbance, and prevent aquatic animals from completing life-cycle changes. Diversions (e.g. trenching) and manipulations (storage and release operations) can result in

diverse ecological consequences that become more severe the greater the degree of alteration of key components of the flow regime (magnitude, frequency, timing, duration of ecological flow components) (Deacon et al. 2007).

- Mining (all minerals and materials): Mining has similar affects to other infrastructure development along with other radical changes including wildlife mortality and displacement due to habitat loss, wind erosion (often leading to decreased air quality due to particulates), soil erosion, disturbance and deposition, ground and surface water contamination, invasion by filaree and Russian thistle in mining pits, toxic chemical runoff and ground water depletion for extraction (J. E. Lovich and D. Bainbridge 1999; Clark and Hothem 1991; Henny et al. 1994; Wilshire 1983).
- Military use/expansion: The use of military lands focuses on training exercises and the support of the military mission. The DOD has made significant steps towards reducing or avoiding long term impacts on natural resources (Prose 1985). In the Southwest, the DOD has proactively engaged regional land management organizations and taken an active role in managing natural resources. Despite this, terrestrial training activities (especially motorized and artillery maneuvers where practiced) reduce vegetation cover, disturb crusts, and degrade and compact soils (Prose 1985; Steiger and Webb 2000). This makes the land more vulnerable to wind erosion (Milchunas et al. 2000; Van Donk 2003) and weed infestation. Some military reservations have also been subject to pollution and contamination by hazardous substances (DOE 1996). The range of impacts will depend widely on the branch of service in question and the missions supported by each base as commented in AMT workshop 1.

  Military activities have generated impacts off reservations, usually in the form of noise pollution (primarily from low-flying aircraft) which has been shown to stress wildlife (Weisenberger et al. 1996) although studies have been unable to document significant impacts due to military noise (Krausman et al. 1998; Ellis et al. 1991).

  As urban areas have encroached on military bases and the nature of missions changed, the DOD has actively sought to expand reservations where it has demonstrated need. The expansion of the Ft Irwin is underway and recently the US Marine Corps has announced its intention to expand its Twentynine Palms base. The Ft Irwin plan has drawn criticism for it translocation of desert tortoise and impacts to other species of concern (Danelski, 2008; USFWS, 2003). Recently DOD has objected to the development of wind turbines near its holdings due to the structures interference with radar and flight operations (Danelski 2010).

  Military protocol restricts some information about CAs and sometimes CEs on installations. This has developed gaps in knowledge about those portions of the Mojave landscape. While some areas have been accessed by researchers and military land use designations have been made public often through Natural Resource Management Plans. The FAA has information about military no-fly zones, low flying areas and flight paths. Treatment of military reservations and the range of activities is complex and makes this a special case CA. We recommend continuing the investigation of the CA through Task 2 data evaluation but it will require greater clarity and data availability to be given adequate treatment in the assessment.
- Air quality impacts (non attainment areas and dust): Air quality is an outcome of land use impacts where plume/deposition areas are mapped or can be modeled. Much like water quality there are point sources (e.g., power plants) and diffuse sources of air pollution such as generalized land disturbance and automobiles. Air quality impacts can be classified into fugitive dust (from construction, mines, ORV use, dewatered lakes) or urban pollution (from automobiles, industrial facilities). Not uncommonly the two combine to increase impacts to air quality. Surface dust directly impacts physiology of Mojave Desert shrubs (Sharifi, 1999) and pollution from the LA basin and Central Valley have impacted plants (Thompson et al. 1980) as

well as visibility degradation in an area historically distinguished by extraordinary visibility (Lovich & Bainbridge, 1999).

- Recreation (OHV use, other intensive recreation, land sales, etc.): The ecological consequences of land-based recreation (ORVs, hiking, mountain biking, horseback riding)and water-based recreation (watercraft) range from soil compaction and erosion, noise, air, direct water pollution, indirect and direct damage to vegetation and wildlife, habitat fragmentation, displacement of sensitive species, introduction and distribution of invasive species, and access to legal hunting and illegal poaching of wildlife (Adams & McCool 2009, Reed & Merenlender 2008).
- Refuse Management: Waste disposal is a CA which is expected to increase with development. In addition to associated infrastructure development, effects on CEs include degradation of ground water (decomposing refuse produces toxic compounds which are often leached into adjacent aquifers linked to aquatic systems), production of methane and volatile organic compound migration toxic to plants and animals, increased road traffic, and dust and windblown litter (Lee G. F. and Jones-Lee A. 2005).
- Exotic ungulate grazing—Parts of the Mojave Desert were subjected to very high stocking rates at the turn of the last century. Today, while many lands are improving, there are still areas where exotic ungulate (i.e. cattle and sheep) grazing may occur at stocking rates that stress ecosystems. In some valleys, exotic ungulate (e.g. cattle and wild burros) impact the same riparian areas and springs. Exotic ungulate grazing impacts include (but are not limited to) trampling and removal of vegetation, destruction of biological soil crusts (which harbor algae, moss and lichen biodiversity), erosion of stream banks, decrease in water quality, widening of streams, increases in water temperatures, allows for terrestrial native and non-native increasers, and aquatic invasives, changes in fish species composition and the reduction in vigor of understory shrubs and herbs (J. E. Lovich and D. Bainbridge 1999; Busack and Bury 1974; Germano and Hungerford 1981; Germano et al. 1983; Germano and Lawhead 1986; in J. E. Lovich and D. Bainbridge 1999; TNC Mojave Ecoregional Plan 2001, Nevada State Wildlife Action Plan 2006). Exotic ungulate grazing pressure can work synergistically with other CAs such as changes in climate, fire regimes and off road recreation. Without assessing the level of pressure exotic ungulate grazing exhibits on Mojave Basin CEs, it will be difficult to access CE resilience and resistance to other stressors such as climate change impacts.

<u>Class III Invasive Species</u>

- Terrestrial Invasive Species (TES) are a primary concern in the Mojave ecoregion. Numerous invasive plant species occur within the ecoregion, seven of which are considered to have substantial ecological impact: (we removed Bermuda grass (*Cynodon dactylon*) from the list per recommendation made at the AMT workshop, as it is probably just around cattle tanks & not very invasive in the desert) Maltastar thistle *(Centaurea melitensis*), Russian thistle *(Salsola iberica*), cheatgrass *(Bromus tectorum*), filaree *(Erodium cicutarium*), red brome *(Bromus rubens*), split grass *(Schismus* spp.) and tamarisk *(Tamarix ramosissima*). These species have been identified for their ability to colonize habitats that were once dominated by native vegetation; in some cases converting entire communities to monocultures (Hunter et al. 1987). Once established, negative impacts may include displacement of native species, decreased beta and alpha diversity, decreased food sources for native wildlife, increased fire frequency and intensity, altered soil processes and soil chemistry, allelopathic effects to native species, and altered geomorphological processes and hydrology. (Marshall et al. 2000; J. E. Lovich and D. Bainbridge 1999).

Based on suggestions from AMT, the following invasive species will be added to the list for the Mojave assessment, Phase II, for degree of impact and data availability.

- Saharan mustard (*Brassica tournefortii*) CAL-IPC 2010
- Crimson fountain grass (*Pennisetum setaceum*) CAL-IPC 2010
- Camelthorn (*Alhagi maurorum*) CAL-IPC 2010
- White top (*Lepidium latifolium*) CAL-IPC 2010
- Buffelgrass (*Pennisetum ciliare*) Sands et al. 2009
- Weeping love grass (*Eragrostis curvula*) Yoshioka et al. 2009
- Date Palm (*Phoenix dactylifera*) Stone et al. 1992
- Russian Knapweed (*Acroptilon repens*) Arizona Invasive Plant Working Group 2005
- Other knapweeds (*Centaurea* spp.) Arizona Department of Transportation 2010

In addition we will also evaluate additional species listed by the California Invasive Plant Council (CAL-IPC 2010) and Arizona Wildlands Invasive Plants Working Group (AZ-WIPWG 2010) during Phase I Task 2 for degree of impact and data availability

- Aquatic Invasive Species (AIS) include invasive species and aquatic viral, bacterial, and other pathogenic and parasitic organisms at multiple trophic levels that impact primary and secondary productivity and lead to competitive exclusion, predation, indirect effects, trophic cascades, etc.) (Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002).The list of aquatic invasive species in the West is large and increasing, but we have limited our efforts in this rapid ecoregional assessment to aquatic invasive/nuisance taxa including the diatom, *Didymosphenia gemenata* (Didymo, rock snot), the Gastropods *Pomacea* sp.(apple snails), *Radix auricularia,* (European ear snail*), Melanoides tuberculatus* (Red-rim melania), *Potamopyrgus antipodarum (*New Zealand mudsnail), and *Cipangopaludina chinensis malleata* (Chinese mystery snail); the bivalves Quagga mussel (Dreissena spp.), Zebra mussel (Dreissena spp.), Asian clam (Corbicula fluminea), several taxa of exotic crayfish, the amphibians: bullfrog (Rana catesbeiana) and African clawed frog (Xenopus laevis); and the fishes: Mollies and Guppies (*Poecilia* sp.), Tilapia (*Oreochromis* sp,), and Asian or European carp (Family *Cyprinidae*). These candidate taxa were selected based on: 1) magnitude of their known or perceived future impacts, 2) need to encompass a full spectrum of various aquatic habitat and trophic level effects, 3) likelihood of their spread, 4) sensitivity of native taxa, and 5) their adaptability to CAs, particularly climate change (e.g., increased water temps, decreased amounts of surface flow water, increased solar radiation, etc.).

Class IV Climate Change

Climate change stress across the Mojave Basin & Range is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts. BLM lands could be especially susceptible to synergistic interactions between current stress from land use practices and climate change. Species' ability to shift their ranges in response to climate changes could also be negatively impacted by barrier-forming activities on BLM lands. As climate change progresses, many species will disperse to new areas as historic habitat becomes inhospitable. Land use practices, such as road building, energy extraction, ORV use, recreation, alternative energy development, and others, are likely to reduce the connectivity of habitat and corridors for movement, thereby reducing dispersal success. Many of these actions also result in habitat loss, disturbance, soil erosion, and sedimentation, causing further stress to aquatic and terrestrial species as they are impacted by climate change.

A synergistic relationship between climate change, invasive species, wildfire, and native species decline has already developed in much of the southwestern U.S. and is expected to continue to worsen. The spread of invasive grasses such as exotic annual grasses into desert and shrub ecosystems has lead to regular fire in systems that historically did not support wildfire. Increased drought stress of the native vegetation from climate change has caused higher susceptibility to fire, leading to loss of native cacti and perennial shrubs. Below we address the two key subclass CAs: temperature change and precipitation change:

- **Temperature Change:** Average temperature change in the Mojave Basin & Range is expected to increase 4-5 degrees F. Average summer (June-August) temperature is expected to increase 4.2-5.8 degrees F while average winter (December-February) temperature will increase 3.3-4.2 degrees F (Maurer et al. 2007). Temperature change is expected to lead to range shifts among plants, animals, and other living things (Parmesan and Yohe 2003). This will also lead to reconfiguration of vegetation assemblages and ecosystems as species react differentially to climate change. Many species that are unable to disperse to new areas may decline in number due to unfavorable conditions (Thomas et al. 2004).

  Increased evaporation and transpiration from higher temperatures will lead to declining soil moisture and increased drought stress in plants, unless offset by substantial increase in precipitation (Dale et al. 2001). Drought stress could lead to loss of native vegetation to fire and insect infestation. Especially at risk are subalpine forests, which are found at higher elevations (USGCRP 2009). Invasive species are expected to increase as native species decline, allowing non-native grasses to invade desert ecosystems. These new grasses can fuel fires in systems that are not adapted to fire, causing further decline among native desert species (USGCRP 2009, Smith et al. 2000).

  Temperature change is expected to have a greater impact on stream flow than precipitation change (He et al. in review), as lower snowpack and earlier snowmelt will both lead to changes in hydrological patterns. Warmer water and lower summer flows are both expected in regional rivers and streams, potentially affecting aquatic species.

  Parts of the Southwest have experienced average temperature increase far higher than the global or national average. Arizona, for example, has warmed by 2.5° F since 1976. In addition, the southwest has experienced long-term drought for over a decade. Desert bighorn sheep reproduction is especially sensitive to precipitation. Desert bighorn sheep are already declining in the Southwest due to drought from current levels of climate change (Epps et al. 2004).

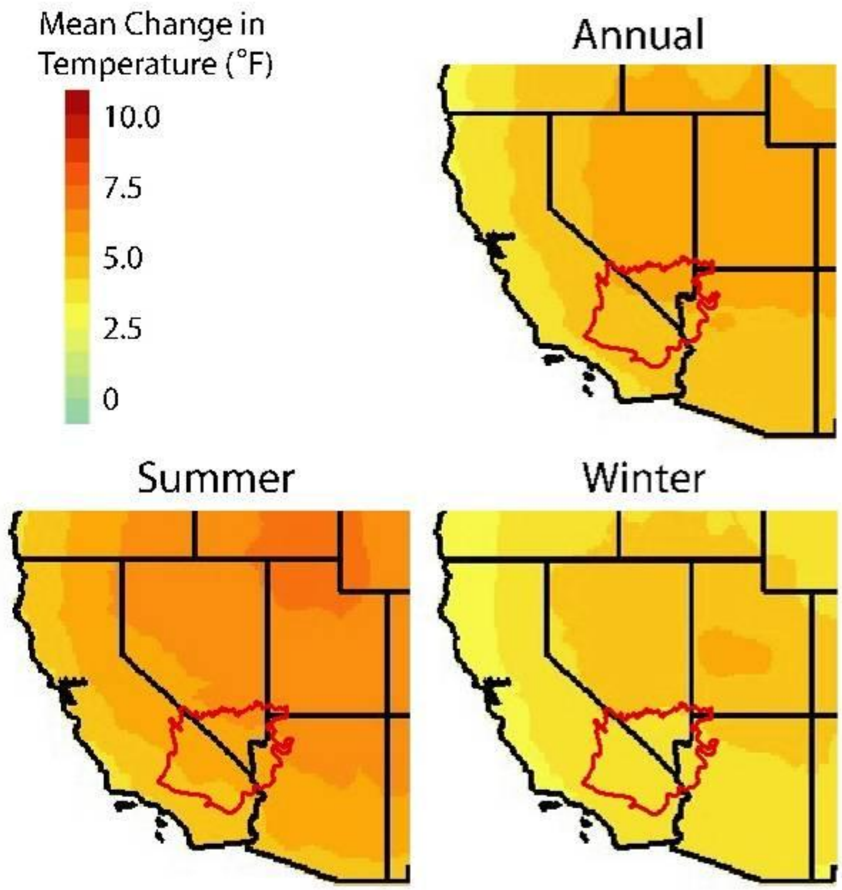

Figure 5. Temperature in the Mojave Basin, change from historic (1961-1990) to mid-century (2040-69) (Maurer et al. 2007)

- **Precipitation Change:** While both the average summer and winter precipitation are expected to increase (+8% to +25% in summer and +4.2% to +16.7% in winter), the average annual precipitation will likely decrease -8% to 0%. The largest change in precipitation is expected in the spring with 12.5% to 29.2% declines (Maurer et al. 2007). Precipitation change projections are highly variable, making it difficult to identify specific ecological effects. The Southwest is expected to become drier, however, even with some seasonal increases in precipitation, due to increased evaporation and loss of snowpack (USGCRP 2009; Lenart et al. 2007, Seager et al. 2007). Longer, more severe, and more frequent drought events are also expected (USGCRP 2009; Lenart et al. 2007, Seager et al. 2007).

  At middle elevations, precipitation is expected to increasingly fall as rain instead of snow, which will result in faster runoff earlier in the spring. Rain on snow events could become more common, leading to sudden influx of water into streams and rivers, possibly causing more floods. Aquifers could receive less recharge due to sudden runoff events rather than slowly melting snow.

Many species will need to shift to new areas with more suitable precipitation patterns in order to persist. Due to the mountainous terrain and land use, however, dispersal corridors allowing many species to move may be unavailable.

With a warmer atmosphere (able to hold more water) and intensified water cycle, there is an increased likelihood of flooding (Lenart et al. 2007). Flooding can lead to greater sedimentation input to streams, decreasing water quality for both people and aquatic organisms. Increases in wildfire and declines in native vegetation will exacerbate this problem due to declining soil stability.

BLM lands in the western U.S. are already heavily impacted by climate change. In the Grand Canyon-Parashant National Monument, for example, Mojave Desert vegetation is in decline due to climate-related increases in fire and long-term drought (BLM 2008). In the Santa Rosa and San Jacinto Mountain National Monument, insect infestations in pine and mixed- conifer forests have led to broad scale vegetation conversions (BLM 2004). In fact, much of the western U.S. is already experiencing beetle infestations that are devastating millions of acres of forest. Drought, possibly brought on by climate change, is thought to be the main culprit in increasing the susceptibility of forest to beetle damage (Breshears et al. 2009).

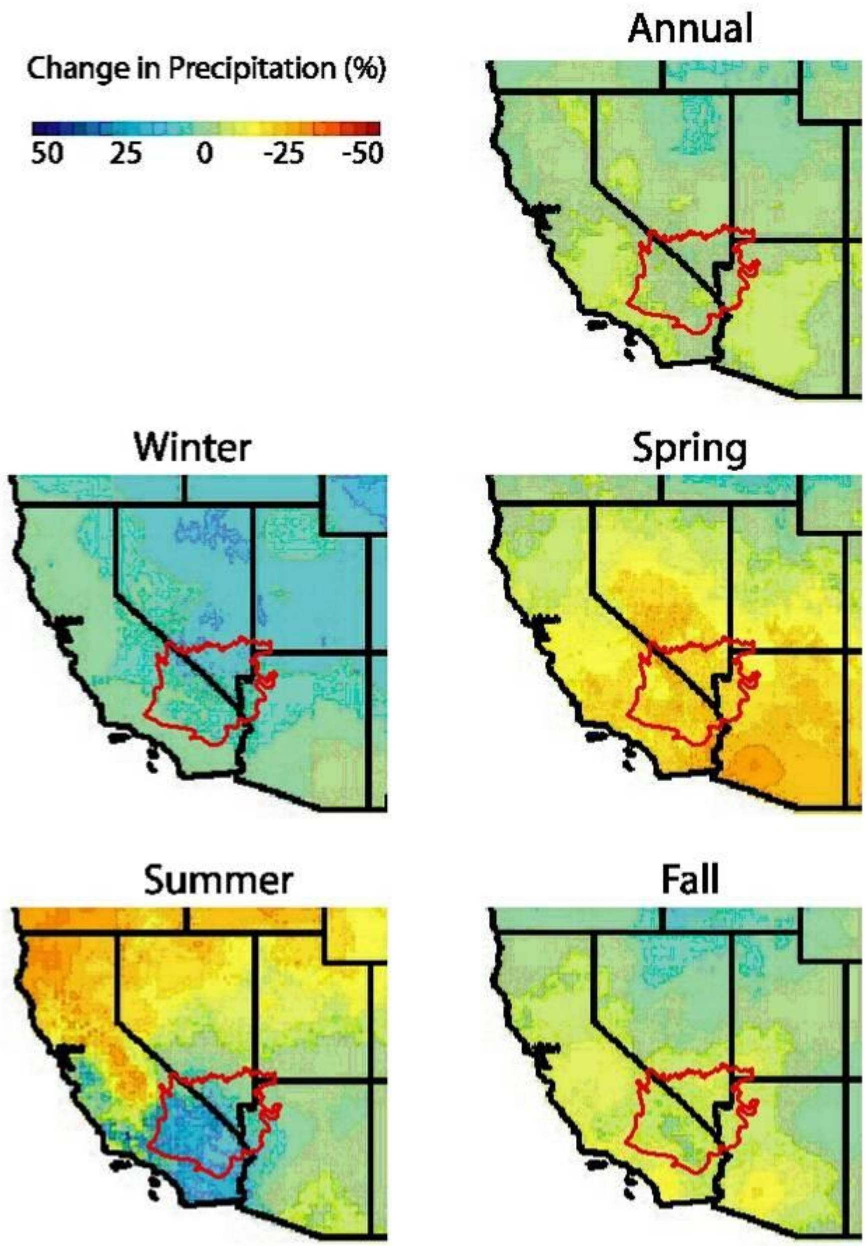

Figure 6. Precipitation in the Mojave Basin, change from historic (1961-1990) to mid-century (2040-69) (Maurer et al. 2007)

Change Agent Assessment Process

A review of literature was conducted pertinent to CAs and their effects on conservation elements. Emphasis was placed on studies and reports regarding the Mojave Desert to assess ecoregionally specific impacts such as invasive species. However, some information was gathered from areas outside of the ecoregion with similar ecological processes (e.g. Sonoran ecoregional plan) when regionally specific information was not available or effects were more universal (e.g. landfill impact on groundwater). This literature was used to assess if the CA is currently a significant impact (in some cases historical, but the impact remains), if it will remain an impact in the future, or if not currently present, it's potential to occur in the ecoregion in the future.

Climate change was assessed using literature review and ClimateWizard, an online climate change query tool (www.climatewizard.org). ClimateWizard can be run with user-defined boundaries so the tool was used to evaluate climate change at the ecoregion level. The evaluations used an ensemble of 16 atmosphere-ocean general circulation models (GCMs) based on the "High A2" emission scenario. The base climate projections are downscaled from the work of Maurer *et al.* (2007).

Change Agent Assessment Table

Greater detail of the assessment is provided in the table in Appendix 3. Definition of fields follow:

1. Change agent name/type: A hierarchical list of change agents evaluated by the team
2. Source: This field will list sources consulted in the characterization and evaluation of the CA.
3. Ecological effects: In general terms, the ecological effects documented by sources.
4. Conservation elements affected: What are the CEs that are affected by the CA? This is not an exhaustive list but draws opportunistically from literature and from the experience of the team members.
5. Effects Conservation elements: How are the CEs affected? As above, not an exhaustive list
6. Key CA synergies: Identifies strong synergies that cause the CA to occur or intensify in the presence of another CA.
7. Current: Identifies if the CA is currently occurring in the ecoregion (subject to further data analysis)
8. Future: Identifies if the CA is forecast to occur (but is not occurring currently) (subject to further data analysis and possible modeling)
9. Include: Can be used by the AMT to evaluate the inclusion of the CA in the subsequent project tasks and to document final decisions of the AMT subject to later filters of data evaluation.

Summary of Key Sources Consulted

- The Nature Conservancy's Mojave Desert Ecoregional Plan (Moore et al. 2001)
- The Nevada State Wildlife Action Plan (WAPT 2006)
- Department of the Interior Mojave Desert Network Vital Signs Report
- The California State Wildlife Action Plan (Bunn et al. 2007)
- Peer review scientific literature (journals include Natural Areas Journal, Journal of Arid Environments, Biological Conservation, Environmental Management, etc.)
- Web related material such as BLM press releases, environmental impact reports from private consulting firms, and various news sources.

Summary of Change Agent Recommendations

1. We found the list of candidate CAs provided by the AMT to be highly relevant and recommend inclusion of all for further assessment for data availability and quality. We also recommend adding <u>alterations to surface water hydrology</u>, as these changes strongly affect fish and other aquatic and riparian CEs. We recommend the addition of exotic ungulate <u>grazing</u> as a CA. While we recognize the difficulty in ecoregional wide consistent data on exotic ungulate grazing, this CA has important synergistic effects with other CAs and would (if feasible) inform the current status and condition of CEs.

2. Atmospheric deposition was added in the Air and Water Quality category to address the impacts of acidification of soil, aquatic systems and root dynamics, nutrient enrichment, and mercury contamination.
3. Terrestrial Invasive Species of primary concern in the Mojave ecoregion include Maltastar thistle (*Centaurea melitensis*), Russian thistle (*Salsola iberica*), cheatgrass (*Bromus tectorum*), filaree (*Erodium cicutarium*), red brome (*Bromus rubens*), split grass (*Schismus* spp.), tamarisk (*Tamarix ramosissima*), Saharan mustard (*Brassica tournefortii*), Crimson fountain grass (*Pennisetum setaceum*), Camelthorn (*Alhagi maurorum*), White top (*Lepidium latifolium*), Buffelgrass (*Pennisetum ciliare*), Weeping love grass (*Eragrostis curvula*), Date Palm (*Phoenix dactylifera*), Russian Knapweed (*Acroptilon repens*) and other knapweeds (*Centaurea* spp.). Additional species may be added during Phase II during data availability assessment of high priority invasive species listed by Arizona, California and Nevada weed lists.
4. Comments at AMT workshop 1 and follow up written comments considered inclusion of tamarisk (leaf) beetle. We had requested provision of a clear MQ regarding this introduced biocontrol species but none were provided. Dialog among recommenders indicated lack of consensus on whether this species constituted a CA, therefore we have not included it in our recommendations.

Recommendations for Future Research

We anticipate most recommendations to be additive as we filter the CE and CA candidates through the following data assessment and proposed modeling with AMT review and input. Several items are likely to drop out as infeasible in the REA. In this Task we identified the following recommendations for future research:

1. Assess BLM's process and capacity for conducting inventory and monitoring of CEs and CAs across the ecoregion.
2. A considerable breadth of empirical research is likely needed to understand the effects of particular CAs on specific CEs.
3. There is clear interest in impacts on soils (erodible, sensitive). Comments suggest further research and modeling beyond the scope of the REA is required.

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Appendices

Appendix 1. Management Questions Assessment

The penultimate Management Questions, based on the preliminary MQs provided by BLM (which can be reviewed in Memo I-1-a) and subsequent review and discussion at AMT1. All MQs are cross-referenced with releant CEs and CAs. Notes refer to additional issues that must be resolved, often in later tasks of Phase 1.

Management Questions: Mojave Basin & Range			
Species			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where is the current distribution of occupied habitat for each CE, including seasonal habitat, and movement corridors?	Each CE		
Where are current CE populations potentially affected by change agents?	Each CE crossed with CAs	All CAs	
What is the current distribution of suitable habitat for each CE?	Each CE		
Where are change agents potentially affecting this habitat and/or movement corridors?	Each CE crossed with CAs	All CAs	
Where are CEs whose habitats are systematically threatened by CAs (other than climate change)?	Subset of CEs with restricted habitats	All CAs	During Task 3, select CE subset
What areas have been surveyed and what areas have not been surveyed (i.e., data gap locations)?	Each CE		
Given current and anticipated future locations of change agents, which habitat areas remain as opportunities for habitat enhancement/restoration?	Subset of CEs		During Task 3, select CE subset or specific habitats.
Where are potential areas to restore connectivity?	Selected subset of habitats and locations.		Determine which CEs have connectivity as a relevant concern. Select subset of habitats or locations.
Where will CEs experience climate outside their current climate envelope?	Each CE	Climate Change	Standard climate envelope analysis
Native Plant Communities			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are intact CE vegetative communities located?	All CEs that are vegetative communities		

Where are the locations that most likely include the highest-integrity examples of each major terrestrial ecological system type?	All CEs that are vegetative communities		Develop metric for Integrity that can be applied to CE communities with available data.
Where will these current communities be potentially affected by Change Agents?	All CEs that are vegetative communities crossed with CAs	All CAs	
Where will current locations of these communities experience significant and abrupt deviations from normal climate variation?	All CEs that are vegetative communities	Climate Change	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Terrestrial Sites of High Biodiversity			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are High Biodiversity sites?	Ecoregion-wide		During Task 3, develop a specific working definition of "high biodiversity". For example, is it just species richness, R? Or richness of CEs?
Where will these High Biodiversity sites be potentially affected by Change Agents?	All High Biodiversity sites (working definition required) crossed with CAs	All CAs	
Where will current locations of these High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All High Biodiversity sites (working definition required)	Climate Change, potentially other CAs	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Aquatic Sites of High Biodiversity			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are Aquatic High Biodiversity sites?	All Aquatic High Biodiversity sites (working definition required)		During Task 3, develop a specific working definition of "high biodiversity". For example, is it just species richness, R? Or richness of CEs?
Where will these Aquatic High Biodiversity sites be potentially affected by Change Agents?	All Aquatic High Biodiversity sites (working definition required) crossed with CAs	All CAs	
Where will current locations of these Aquatic High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All Aquatic High Biodiversity sites (working definition required)	Climate Change	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Specially Designated Areas of Ecological Value			

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Where are specially designated areas of ecological value?	Ecoregion-wide		Define subset from the list of CEs or other designated locations.
Exotic Ungulate Grazing (Wild Horses, Burros)			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are the current of Wild Horses?	Wild horses		
Where are the current of Burros?	Burros		
Where are the current Herd Management Areas (HMAs)?	Wild horses, Burros		
Which HMAs are exceeding AML?	Wild horses, Burros	Exotic Ungulate Grazing	
Which current MHA will experience significant effects of Change Agents?	HMAs, Grazing	All CAs	
Which current Allotments will experience significant effects of Change Agents?	Allotments, Grazing	All CAs	
Which Allotments and HMA will experience climate outside their current climate envelope?	HMAs, Allotments, Grazing	Climate Change, Exotic Ungulate Grazing	Standard climate envelope analysis
Soils			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are target soil types within the ecoregion?	Ecoregion-wide		Develop list of relevant soil types.
Where will these target soil types be potentially affected by Change Agents?	All target soil types (working definition required) crossed with CAs	All CAs	
Where will current locations of these High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All target soil types (working definition required)		TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Surface and Subsurface Water Availability			
Where are current water resources, both natural and man-made?	All surface water bodies		Note: coordinate with a related question in Groundwater Extraction.
Of these water resources, which are perennial, ephemeral, etc?	All surface water bodies		

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Of these water resources, what is their surface water/groundwater connectivity?	All surface water bodies		
Where will these water resources be potentially affected by Change Agents?	All surface water bodies crossed with CAs	Many CAs	
Where are the aquifers and their recharge areas?	All relevant areas		
What is the natural range of variation in high and low water levels or flows (e.g., frequency, timing, duration of high and low water levels or flows)?	All surface water bodies		

Aquatic Ecological Function and Structure

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
What is the condition of target aquatic systems? OR What is the condition of target aquatic systems in terms of PFC?	All surface water bodies (may require a subset)	Hydrologic alternation, Invasive species, Development	Many may not have "PFC" defined, especially if they are not riparian. Need to look beyond "function and structure" to look at factors that may contribute to resistance and resilience in the face of disturbances and change agents. This requires a conceptual model: What are the ecological and environmental factors that contribute the most to ecological structure and function, including resistance and resilience in the face of disturbances and change agents? To be developed further during Task 3.
Where are the degraded aquatic systems (e.g., water quality)?	All surface water bodies	Hydrologic alternation, Invasive species, Development	Requires a working definition of degraded. TBD in a conceptual model.

Fire History

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
What areas have experienced significant fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	

In places that have experience fire, where does the resulting vegetative structure and composition differ from the desired state?	Among locations that have experience significant fire	Wildfire (increased and/or decreased frequency)	Requires, for each location, a definition of what constitutes "desired state". TBD in Task 3.
Fire Potential			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where recurrent areas with high potential for fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	Devise a working definition of "potential for fire". TBD in Task 3.
Where are areas that in the future will have high potential for fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	Devise a working definition of "potential for fire". TBD in Task 3. Based on climate changes and potential changes in vegetation. Coordinate with other relevant MQs.
Invasive Species			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
What is the current distribution of invasive species included as CAs?	Ecoregion-wide	All invasive species CAs	
What areas are significantly ecologically affected by invasive species?	Ecoregion-wide	All invasive species CAs	Requires a working definition of "significantly ecologically affected". Various definitions are possible (e.g., dominance, alterations of ecological function, in some cases mere presence). AMT should discuss possible definitions.
Where are areas (significantly effected by invasives) that have restoration potential?	Areas identified as significantly affected by invasives.	All invasive species CAs	Requires working definition of "restoration potential. There should be specific definitions for each invasive species under consideration.
Given current patterns of occurrence and expansion ,what is the potential future distribution of invasive species included as CAs?	Ecoregion-wide	All invasive species CAs	Based on climate changes and recent patterns of occurrence and expansion.
Where are areas of nitrogen deposition?	Ecoregion-wide		Why is this question posed under "invasive species"? We have several concerns about pollution, including atmospheric deposition (nutrients, acid, mercury, etc.); shouldn't we have a separate Change Agent listing for these?
Urban & Roads Development			

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Where are current locations of relevant development types?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	
Where are areas of planned or potential development (outside of current urban areas)(e.g., under lease, plans of operation, governmental planning), including transmission corridors?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	Based on available planning documents.
Where are the areas of significant ecological change from these anthropogenic activities?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	Based on areas thought to be the targets of development. Develop a working definition of "potential development" that incorporates proximity to existing urban areas, roads, or power lines. Develop a working definition of "significant ecological changed". TBD in Task 3.
Where do locations of current CEs overlap with areas of potential change from anthropogenic activities?	All CEs	Development, Transportation and Energy Infrastructure	Coordinate with Species and other CE-related MQs. This MQ may obviate the MQ "Where are the areas of significant ecological change from these anthropogenic activities?"
Where are ecological areas with significant recreational use?	Ecoregion-wide	Recreation (land-based, water-based)	
Oil, Gas, and Mining Development			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are the current locations of Oil, Gas, and Mining (including gypsum) development?	Ecoregion-wide	Extractive energy development	Based on available data and planning documents.
Where are areas under plans of operation?	Ecoregion-wide	Extractive energy development	Based on available data and planning documents.
Where are areas under lease?	Ecoregion-wide	Extractive energy development	Based on available data and planning documents.
Where are areas with mineral deposits, free use permits, or community pits?	Ecoregion-wide	Extractive energy development	Based on available data and planning documents.
Where are the areas of potential future locations of Oil, Gas, and Mining (including gypsum) development (locatable, salable, and fluid and solid leasable minerals?	Ecoregion-wide	Extractive energy development	Based on available planning documents and known distributions of resources.
Where do locations of current CEs and other relevant resources overlap with areas of potential future locations of energy development?	All CEs, relevant other resources (including water resources)	Extractive energy development	Coordinate with Species and other CE-related MQs.
Renewable Energy Development			

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Where are the current locations of renewable energy development (solar, wind, geothermal, transmission, and any other upcoming renewable technologies)?	Ecoregion-wide	Renewable energy development	Based on available data and planning documents.
Where are the areas of potential and physically possible locations for renewable energy development?	Ecoregion-wide	Renewable energy development	Based on planning documents. Also potentially requires definitions of minimum physical conditions for certain development types (e.g., wind maps, etc). Coordinate with Groundwater Extraction MQs.
Where are the areas suitable for off-site mitigation and conservation efforts?	Among current and potential development sites.	Renewable energy development	Requires a working definition of suitable mitigation. Should be developed during Task 3, and specific to CEs and locations.
Where do locations of current CEs and other relevant resources overlap with areas of potential future locations of renewable energy development?	All CEs, relevant other resources (including water)	Renewable energy development	Coordinate with Species and other CE-related MQs.
Groundwater Extraction and Transportation			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where will change agents be more powerful if groundwater is extracted?	Ecoregion-wide	All CAs	
Where are areas with groundwater resources available to sustain renewable energy projects that would not degrade aquatic ecosystems that also depend on these groundwater resources.	Ecoregion-wide	Hydrologic Alteration, Renewable Energy Development	Coordinate with Renewable Energy MQs
Where are the areas showing effects from existing groundwater extraction?	Ecoregion-wide	Hydrologic Alteration	What kinds of "effects" are meant here? If ecological, must say so explicitly. Rephrase
Where are artificial water bodies including evaporation ponds, etc.?	Ecoregion-wide		Note: Coordinate with an MQ in Surface Water.
Where are the areas with groundwater basins in an overdraft condition?	Ecoregion-wide	Hydrologic Alteration	This is not a question about areas where existing groundwater extraction is having ecological effects (already addressed above), but a question of where groundwater extraction exceeds the long-term potential for recharge.
Surface Water Consumption and			

Diversion			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are the areas of potential future change in surface water consumption and diversion?	Ecoregion-wide	Hydrologic alteration, Climate change, Development	This should show up in any analysis of where “development” growth is most likely; and in the mapping of where water-intensive energy development is most likely.
Where are the areas with surface water resources available to sustain solar power, and other forms of development without degrading aquatic ecosystems that also depend on these groundwater resources?	Ecoregion-wide	Renewable energy development	Coordinate with Renewable Energy MQs. This is an extension of the mapping of where surface waters exist that depend on groundwater levels or discharges for their hydrology, combined with the mapping of development potential.
Where are the areas showing ecological effects from existing surface water exploitation?	Relevant CEs	Hydrologic alteration, Development	Generate this information by coupling map information on density of surface water use (diversions as well as consumption) from state and USGS reports, with information on degree of degradation of aquatic ecological integrity.
Where are artificial water bodies including evaporation ponds, etc.?	Ecoregion-wide		Coordinate with an MQ in Surface Water.
Where are the areas with existing surface water extraction that has caused natural aquatic communities to become entirely dry, either seasonally or perennially?	Relevant CEs	Hydrologic alteration, Development	Generate this information by coupling map information on existence of formerly perennial streams with where they don't exists anymore, and overlay information on intensity of upstream and adjacent surface water extraction.

Climate Change: Terrestrial Resource Issues			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where will changes in climate be greatest relative to normal climate variability?	Ecoregion-wide	Climate Change	Climate change will affect every location, but affect different locations in different ways. So the issue is not where any effects will occur, but where these effects will potentially cause significant ecological change affecting priority conservation elements. Exact climate models are TBD.
Given anticipated climate shifts and the direction shifts in distributions, where are areas of potential habitat fragmentation?	Ecoregion-wide	Climate Change	Fragmentation may be difficult to assess. Consider species-specific responses/perceptions of fragmentation.
Which native plant communities will experience climate completely outside their normal range?	CEs that are plant communities.	Climate Change	Climate envelope studies are complicated by the likelihood that assemblages will not move intact, but shift and reform based on the movements of individual species. This MQ needs further refinement during Task 3 and the analysis. Coordinate with MQ in "Native Plant Communities".

Where will wildlife habitat experience climate completely outside its normal range?	Select relevant wildlife species	Climate Change	Requires a working definition of "wildlife habitat". Coordinate with the "plant communities and climate change MQ".
Where are wildlife species ranges (on the element list) that will experience significant and abrupt deviations from normal climate variation?	Select relevant wildlife species	Climate Change	Consider further reframe as standard climate envelope analysis.
Based on recent distributions and expansion patterns of insect pests and disease, what are expected distributions in the future?	Select relevant pest species	Climate Change, Invasive species	This is a research questions that possibly requires speculation beyond the scope of the REA. This MQ remains provisional, and be dropped and listed as a gap in research.
Climate Change: Aquatic Resource Issues			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where aquatic resources that will experience significant and abrupt deviations from normal climate variation?	Ecoregion-wide	Climate Change, Hydrologic alteration	Climate change will affect every location, but affect different locations in different ways. So the issue is not where any effects will occur, but where these effects will potentially cause significant ecological change affecting priority conservation elements.
Where are aquatic resources that will experience significant and abrupt deviations from normal flow regime or mean water levels?	Ecoregion-wide	Climate Change, Hydrologic alteration	There will potentially include effects on water levels in wetlands and groundwater-driven systems, and changes in riparian inundation patterns. Plus the changes won't be in simple magnitude but may also be in the timing, duration, and frequency of different hydrologic conditions.
Where aquatic resources that will experience significant and abrupt deviations from normal temperature regime?			
Where will aquatic resources experience significant and abrupt deviations from normal temperature regime?	Ecoregion-wide	Climate Change, Hydrologic alteration	Both "flow" and "hydrologic change will occur. Includes not just "temperature change" but change in the temperature regime.
Where are aquatic resources that will experience additional effects on physical habitat such as channel morphology due to significant and abrupt deviations in climate and hydrologic regimes?	Ecoregion-wide	Climate Change, Hydrologic alteration	
Military Constrained Areas			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**

Where are military constrained areas?	Ecoregion-wide	Military use areas, conflict of use areas, areas of moratoria, potential military expansion, DOE contracted areas, installation boundaries	
Where might these areas change in the future?	Ecoregion-wide	Military use areas, conflict of use areas, areas of moratoria, potential military expansion, DOE contracted areas, installation boundaries	Coordinate with various other MQs on climate change and water resources. Consult INRMP of the relevant installations to determine available data and potential presence of CEs and CAs.
Where are areas of possible expansion of military use?	Ecoregion-wide	Potential military expansion	Based on BRAC or other planning documents.
Atmospheric Deposition			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are areas affected by atmospheric deposition of pollutants (nutrient deposition, acid deposition, mercury deposition)?	Ecoregion-wide	Air and Water Quality: Fugitive dust, air pollution, atmospheric deposition	Atmospheric deposition affects ecosystems via both nutrient enrichment and via acid deposition; and affects some individual species through these effects and through mercury deposition. This is a known problem in the higher elevations of the western US.

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
	83.5%	***Basin Dryland Ecosystems***				
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	**33.8%**	**Warm Semi-Desert**	This widespread warm desert scrub occurs in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This sparse to moderately dense shrubland is composed of creosotebush and white burrobush, but many different shrubs, dwarf-shrubs, and cacti may be present. Other common plants include desert-holly, brittlebush, Nevada joint-fir, ocotillo, and beavertail cactus. Grass and herb cover is sparse, except during springs after above average winter rains when ephemeral annual plants carpet the desert floor.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Mojave Mid-Elevation Mixed Desert Scrub	**32.5%**	**Warm Semi-Desert**	This desert scrub occurs above lower-elevation creosotebush desert scrub and below pinyon-juniper woodlands and chaparral of the eastern, central and western Mojave Desert and extends north into the Great Basin transition area. These evergreen shrublands often have an open canopied shrub layer of blackbrush, California wild buckwheat, Nevada joint-fir, spiny hop-sage, greenfire or bladder-sage. Scattered cacti and succculents such as beargrass, buckhorn cholla, Mojave yucca or the Joshua tree (tree yucca) may be present. Desert grasses, including Indian ricegrass, desert needlegrass, James' galleta, or big galleta may form an grass layer. Scattered juniper trees or desert scrub species may also be present.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
North American Warm Desert Pavement	**8.8%**	**Warm Semi-Desert Cliff, Scree & Other Rock Vegetation**	This ecological system occurs throughout much of the warm deserts of North America and is composed of unvegetated to very sparsely vegetated (<2% plant cover) landscapes, typically flat basins where extreme temperature and wind develop ground surfaces of fine to medium gravel coated with "desert varnish". Very low cover of desert scrub species such as creosotebush or California wild buckwheat is usually present. However, ephemeral herbaceous species may have high cover in response to seasonal precipitation, including devil's spineflower, Indian-pipeweed, and hairy desert-sunflower.	Upland, Wind and Erosion	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses degree of intactness of desert varnish degree of soil compaction or disturbance from non-natural sources
North American Warm Desert Bedrock Cliff and Outcrop	**2.4%**	**Warm Semi-Desert Cliff, Scree & Other Rock Vegetation**	This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include elephant-tree, ocotillo, Bigelow's bear-grass, teddy-bear cholla, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 ha (5 acres) in size from adjacent areas.	Upland, Wind and Erosion	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, proportions of different patch types (e.g. woodland, shrubland, bare rock) degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
Sonoran Mid-Elevation Desert Scrub	**2.2%**	**Warm Semi-Desert**	This desert scrub occurs between northern edge of the Sonoran Desert and the chaparral dominated slopes of the Mogollon Rim/Central Highlands region in Arizona and on lower slopes of several desert ranges such as the Bradshaw, Hualapai, and Superstition mountains. Sites are found in a relatively narrow elevational band (750 -1300 m) that is too high/cold for the frost sensitive warm desert species such as saguaro and paloverde and too dry for the chaparral species common in the Mogollon Chaparral. Soils are generally rocky. Common species present are creosotebush, narrowleaf goldenbush, California wild buckwheat, and taller shrubs such as crucifixion-thorn or jojoba that form an open shrub layer.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Sonora-Mojave Mixed Salt Desert Scrub	**1.7%**	**Warm Semi-Desert**	This warm desert scrub forms extensive open-canopied shrublands in salty soil basins in the Mojave and Sonoran deserts. They are often found around playas (dry lakes) that occasionally fill following rain. Soils are generally fine-textured (clays). Common shrubs are fourwing saltbush, cattle-spinach, or other saltbushes. Allenrolfea, pickleweed, seepweed, or other salt-loving plants are often present. The grasses, alkali sacaton and saltgrass may be present at varying densities.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
North American Warm Desert Badland	**1.0%**	**Temperate & Boreal Cliff, Scree & Other Rock Vegetation**	This sparsely vegetated to barren ecological system occurs in the southwestern deserts on heavy clay soils forming "badlands" with excessive erosion. The harsh soil properties and high rates of erosion and deposition prevent most plant growth. However, sparse shrubs such as desert-holly and a few herbs are often present.	Upland, Wind and Erosion	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, proportions of different patch types (e.g. shrubland, bare soil) degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
Great Basin Xeric Mixed Sagebrush Shrubland	**0.7%**	**Cool Semi-Desert**	Low growing sagebrush shrublands are found throughout the Great Basin, and extending into the northern Mojave Desert, on dry flats and plains, alluvial fans, rolling hills, rocky hillslopes, saddles and ridges. Usually they are found below the zone of pinyon-juniper woodlands. These habitats are dry (xeric), often exposed to desiccating winds, and the soils are shallow, rocky, and not-salty. Black sagebrush (mid and low elevations), Lahontan sagebrush, or alkali sagebrush (higher elevation) are the most common sages, but Wyoming big sagebrush may also also common. Rabbitbrush, shadscale, jointfir, goldenbush, spiny hop-sage, Shockley's desert-thorn, bud sagebrush, black greasewood, and horsebrush are some of the other shrubs. Grasses and herbs are also found but are not very abundant because of the dry conditions.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover species richness, % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
North American Warm Desert Active and Stabilized Dune	**0.2%**	**Warm Semi-Desert Cliff, Scree & Other Rock Vegetation**	These sites are composed of unvegetated to sparsely vegetated dunes and sandsheets. Common plants includes white burrobush, desert sand-verbena, sand sagebrush, fourwing saltbush, creosotebush, big galleta, rosemary-mint, mesquite, and littleleaf sumac. Dune "blowouts" and subsequent stabilization through succession are characteristic processes. Aeolian (wind) processes define this system and are key to maintaining a mosaic of active and stabilized areas within the dune field and sandsheet.	Upland, Wind and Erosion	Landscape Connectivity Natural Disturbance Regime (sand dynamics) Native Vegetation Composition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover proportions of open/migrating, native species anchored and native species stabilized stages % cover native or human sensitive species, % cover invasive or native increaser species, presence of native sand-adapted species

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
Inter-Mountain Basins Mixed Salt Desert Scrub	**0.1%**	**Cool Semi-Desert**	In the interior western U.S., salt desert shrublands are found in some of the driest of basins, slopes and plains. The soils usually have a high percentage of salts or calcium, often because of the rocks from which the soil is derived, or because of the high rate of evaporation of water from the surface of the soil. These salt desert shrublands experience extreme climatic conditions, with warm to hot summers, freezing winters, and low amounts of rain or snowfall. The shrubs are adapted to these dry, "saline" conditions, often having spines and small leaves, and may go dormant during extended dry periods. The most common shrubs are called "saltbush" species and include shadscale, fourwing saltbush, cattle-spinach, spinescale, spiny hopsage, or winterfat. They usually are low-growing and scattered, but sometimes can be dense. Grasses and herbs are also found, but because of the dry conditions are rarely abundant.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
	6.2%	***Basin Wet Ecosystems***				

Appendix 2 Coarse Filter Conservation Elements				**Ecological Integrity Factors**		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
North American Warm Desert Playa	**4.5%**	**Warm Semi-Desert**	Desert playas are found across the warm deserts of North America, from western Texas to southern California. Playas are depressions that are intermittently flooded, followed by evaporation, leaving behind a residue of salts. Surface soils textures are variable but there is often an impermeable subsoil layer that keeps water near soil surface. Bare ground and salt crusts are abundant on soil surface with small salt grass beds in depressions and sparse shrubs around the margins. Other common plants include iodinebush, seepweed, marsh spikerush, ricegrass, crinklemat, or saltbush. Occasionally, herbaceous plants may temporarily cover ground surface during wet periods, but then dry up and blow away. Large desert playas tend to be defined by rings of plants formed in response to salt tolerance. Playas are often sources areas for sand that is blown from playa to dunes downwind.	Intermittent Flooding, Evaporation, Wind	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) % cover native or human sensitive species, % cover invasive or native increaser species bare soil due to natural depositional processes, or game trails
North American Warm Desert Wash	**1.5%**	**Warm Semi-Desert**	These intermittently flooded washes or arroyos often dissect alluvial fans, mesas, plains and basin floors throughout the warm deserts of North America. Although often dry, the stream processes define this type, which are often associated with rapid sheet and gully flow. Desert wash plants may be sparse and patchy to moderately dense, typically occurring along the banks, but occasionally within the channel. Plants are quite variable but are mostly shrubs and small trees such as apache plume, black greasewood, catclaw acacia, desert-willow, desert almond, littleleaf sumac, and mesquite. Washes are important habitat for many animals in the desert.	Intermittent Flooding, Evaporation	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & bare soil due to natural depositional processes

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
North American Warm Desert Riparian Woodland and Shrubland	**0.2%**	**North American Warm Temperate Flooded & Swamp Forest**	These woodlands and shrublands occur along lower elevation rivers and streams in desert valleys and canyons in the southwestern US. Common trees include box-elder, velvet ash, Fremont cottonwood, Goodding's willow, arroyo willow, netleaf hackberry, and Arizona walnut. The shrublands are often composed of Geyer's willow, silver buffaloberry, and coyote willow.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails
North American Warm Desert Riparian Mesquite Bosque	**0.0%**	**North American Warm Temperate Flooded & Swamp Forest**	These mesquite woodlands and forests occur along rivers and streams in valleys of Arizona and New Mexico, and adjacent Mexico. The tree or tall shrub canopy is either honey mesquite and velvet mesquite with mulefat, arrow-weed, and coyote willow commonly present in a shrub layer. Mesquites tree and other moisture-loving plants, tap groundwater below the streambed when surface flows stop. These plants are dependent upon annual rise in the water table for growth and reproduction.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
North American Arid West Emergent Marsh	**0.0%**	**Temperate & Boreal Freshwater Marsh**	These are natural marshes that occur in depressions (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (sloughs). They are frequently or continually flooded with water depths up to 6 feet deep, but have rooted, mostly grasslike plants. They usually have peat or muck in the bottom and occur in dry environments, typically surrounded by savanna, shrub-steppe, steppe, or desert vegetation. Common emergent and floating vegetation includes bulrushes, cattails, rushes, pondweeds, knotweeds, pond-lilies, and canarygrass	Groundwater	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) diversity of native species, % cover native or human sensitive species, % cover invasive or native increaser species, amount of organic matter accumulation bare soil due to natural depositional processes, or game trails
Mojave Desert Springs and Seeps	**0.0%**	**Warm Semi-Desert**	These are found either as artesian outflow from rock or alluvium at the base of slopes. They may be isolated or adjacent to slow-flowing streams. They are frequently or continually flooded, but with very shallow water depth. Some may include marshy vegetation around their margins. They usually have a mineral bottom and occur in dry environments, typically surrounded by desert scrub or shrub-steppe. If present, emergent and floating vegetation includes bulrushes, rushes, or pondweeds.	Groundwater	Watershed Connectivity Hydrology Native Aquatic Composition Surrounding Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) diversity of native species, % native or human sensitive species, % invasive or native increaser species bare soil due to natural depositional processes, limited compaction
	2.5%	***Montane Dryland Ecosystems***				

Appendix 2 Coarse Filter Conservation Elements				**Ecological Integrity Factors**		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
Great Basin Pinyon-Juniper Woodland	**1.9%**	**Cool Temperate Forest**	These woodlands occur on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada. They are found on warm, dry sites on mountain slopes, mesas, plateaus and ridges, above the valleys where sagebrush is dominant. Severe weather events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to a relatively narrow altitudinal zones. Singleleaf pinyon and Utah juniper, alone or mixed together, are the main trees. Curl-leaf mountain-mahogany is also common with the pinyon-juniper. Shrubs and grasses may be abundant to absent all together. Typical species include manzanita, sagebrush, blackbrush, turbinella live oak, needle-and-thread grass, Idaho fescue, bluebunch wheatgrass, great basin lyme grass, and muttongrass.	Upland, Fire Regime	Landscape Connectivity Natural Disturbance Regime (fire) Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover evidence of recent fire in appropriate sites (deep soils) tree density, % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, % cover of native perennial grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Mogollon Chaparral	**0.5%**	**Cool Semi-Desert**	This shrubland occurs across central Arizona (Mogollon Rim), western New Mexico, southern Utah and Nevada. It is the common shrubland system along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into the southwestern mountains (1000-2200 m). It occurs on foothills, mountain slopes and canyons in hotter and drier habitats below oak and ponderosa pine woodlands. These are usually dense shrublands with a mix of species such as turbinella live oak, Toumey oak, shaggy mountain-mahogany, crucifixion-thorn, Mojave Desert whitethorn, Wright's silktassel, Stansbury's cliffrose, sugarbush, skunkbush, and Mexican manzanita or pink-bracted manzanita at higher elevations. Scattered remnant pinyon and juniper trees may be present. Most chaparral species are adapted to fires, growing from rootstock after burning or producing fire-resistant seeds. Examples occurring within montane woodlands are a result of recent fires.	Upland, Fire Regime	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of non-natural fragmentation of larger landscape, % of larger landscape in natural land cover, landscape-level fire return interval % cover native or human sensitive species, % cover invasive or native increaser species, % recovery of fire-adapted shrubs post-fire degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements				Ecological Integrity Factors		
Ecosystem Name	**% of Ecoregion**	**National Vegetation Classification: Formation**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Measurable Indicators**
Sonora-Mojave Semi-Desert Chaparral	**0.2%**	**Warm Semi-Desert**	This evergreen shrubland (chaparral) occurs above low-elevation desert scrub and below pinyon-juniper woodlands of the western Mojave and Sonoran deserts and extends from southern California into Baja Norte, Mexico. Shrubs are variable and include John-Tucker oak, Muller oak, California scrub oak, greenleaf manzanita, Mexican manzanita, birchleaf mountain-mahogany, Mojave Desert whitethorn, and California juniper. Fires are an important ecological process in chaparral. Most chaparral plants are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds.	Upland, Fire Regime	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of non-natural fragmentation of larger landscape, % of larger landscape in natural land cover, landscape-level fire return interval % cover native or human sensitive species, % cover invasive or native increaser species, % recovery of fire-adapted shrubs post-fire degree of soil compaction or disturbance from non-natural sources
	0.0%	***Montane Wet Ecosystems***				
North American Warm Desert Lower Montane Riparian Woodland and Shrubland	**0.0%**	**North American Warm Temperate Flooded & Swamp Forest**	These are riparian woodlands and shrublands found in the foothills and mountain canyons and valleys of southern Arizona, New Mexico, and adjacent Mexico. They are usually narrow wet habitats along the streams, with a patchy mosaic of open woodlands or forests, willows, rushes, sedges, and moist herbs and grasses. Common trees include narrowleaf cottonwood, Rio Grande cottonwood, Fremont cottonwood, Arizona sycamore, Arizona walnut, velvet ash, and wingleaf soapberry. Coyote willow, plum spp., Arizona alder, and mulefat are common shrubs. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails

Appendix 3. Change Agent Assessment

See text for explanation of fields. The "Include" field identifies those CAs vetted and recommended for inclusion by the AMT.

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Wildfire								
Increased fire frequency	Mojave Desert Network Vital Signs Monitoring Plan; Nevada State Wildlife Action Plan (WAPT 2006)	Invasion by exotic annual grass species such as *Bromus* spp. and *Schismus* spp. results in increased fuel continuity, fire frequency, and fire intensity	Sonora-Mojave Creosote Bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Greater fuel load provided by invading grasses may result in shrub mortality due to increased fire duration and intensity. Compromised small mammal and lizard habitat and food sources.	Disturbances such as exotic ungulate grazing or development promote invasion of *Bromus* and *Schismus* spp.	X		
Decreased fire frequency	Wisdom et al. 2003	Fire suppression promotes invasion of pinyon and Juniper	Great Basin Xeric Mixed Sagebrush Shrubland	These systems are most susceptible as pinyon-juniper establishment is most likely on wet, cool sites with moderately deep soil		X		
Development								
Urbanization subclass	Theobald 2001;2005; US EPA 2009, Arizona GFD 2006, Bunn et al. 2007, WAPT 2006	Habitat destruction and fragmentation and modification of ecological processes (), introduction of non-native invasive species ; Arizona GFD 2006, Bunn et al.2007; WAPT 2006	Mohave desert scrub, lower-Colorado river Sonoran desert scrub, semi-desert grassland, desert tortoise & Mohave ground squirrel (Bunn et al. 2007, WAPT 2006)			X	X	
Urban commercial/industrial			Riparian ecosystems			X	X	
Urban residential (>1 per 2 ac)							X	
Exurban residential (1 per 2 - 40 ac)			Wetlands, springs & seeps			X	X	
Agriculture								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Exotic Ungulate Grazing	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Busackand Bury 1974; Germano and Hungerford 1981; Germano et al. 1983; Germano and Lawhead 1986; in J. E. Lovich and D. Bainbridge 1999; Nevada State Wildlife Action Plan (WAPT 2006), Webb and Stielstra 1979	Removal and trampling of native vegetation by domestic and feral herbivores, soil disruption including riparian damage, trampling and destruction of mammal and reptile burrows, utilization of artificial water sources, water contamination, invasion and spread of non-native plants	Sonora-Mojave Creosote Bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub, aquatic systems.	Reduced populations of native plant species, increased competition by non-native plant species, habitat and food source loss for animals as a result of community transition. Reduced prey sources for predators	Disturbances such as exotic ungulate grazing or development promote invasion of non-native plant species	X		
Transportation and energy infrastructure								
Roads	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Vasek et al. 1975; Nicholson 1978; Garlandand Bradley 1984; Boarman and Sazaki 1996; Jennings 1991; Rosen and Lowe 1994; Wilshire and Prose 1987; Zink et al. 1995	Complete removal of vegetation, complete destruction of animal habitat. Animal mortality on roadways, increased access for the illegal vandalism of plants and animals, increased erosion, corridor expansion for non-native species which thrive on disturbance.	All conservation elements adjacent to and within corridors.	Restricted gene flow as a result of fragmentation. Decreased wildlife and plant populations due to habitat loss and increased competition by non-native plants. Reduced plant biomass down slope of corridors due to water diversion (J. E. Lovich and D. Bainbridge 2008)		X	X	
Transmission corridors	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Vasek et al. 1975; Artz 1989; Zink et al. 1995; J. E. Lovich and D. Bainbridge 1999	Partial to complete removal of vegetation, partial to complete destruction of animal habitat, habitat fragmentation, retardation of habitat recovery due to maintenance, expansion of nesting sites for raptors in transmission towers, corridor expansion for non-native species which thrive on disturbance, extensive trenching and construction of diversion structures.	All conservation elements adjacent to and within corridor.	Restricted gene flow as a result of fragmentation, increased predation by raptors. Decreased wildlife and plant populations due to habitat loss and increased competition by non-native plants. Reduced plant biomass as a result of water diversion.		X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Water transmission	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Vasek et al. 1975; Artz 1989; Zink et al. 1995; J. E. Lovich and D. Bainbridge 2000	Partial to complete removal of vegetation, partial to complete destruction of animal habitat, habitat fragmentation, retardation of habitat recovery due to maintenance, corridor expansion for non-native species which thrive on disturbance, extensive trenching and construction of diversion structures.	All conservation elements adjacent to and within corridor.	Restricted gene flow as a result of fragmentation, Decrease in wildlife and plant populations due to habitat loss and increased competition by non-native plants. Reduced plant biomass as a result of water diversion.		X	X	
Gas pipelines	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Vasek et al. 1975; Artz 1989; Zink et al. 1995; J. E. Lovich and D. Bainbridge 2001	Partial to complete removal of vegetation, partial to complete destruction of animal habitat, habitat fragmentation, retardation of habitat recovery due to maintenance, corridor expansion for non-native species which thrive on disturbance, extensive trenching and construction of diversion structures.	All conservation elements adjacent to and within corridor.	Restricted gene flow as a result of fragmentation, Decrease in wildlife and plant populations due to habitat loss and increased competition by non-native plants. Reduced plant biomass as a result of water diversion.		X	X	
Extractive energy development								
Mining	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Clark and Hothem 1991; Henny et al. 1994; Wilshire 1983; Mojave Desert Network Vital Signs Monitoring Plan	Habitat loss, animal mortality wind erosion , brine evaporation and dry lake mine operations lead to substantial wind erosion, soil erosion, disturbance and deposition, ground and surface water contamination, invasion by filaree and Russian thistle in mining pits, toxic chemical runoff and ground water depletion for extraction.	All conservation elements adjacent to and within extraction operations and hydrologically connected aquatic systems.	Cyanide extraction techniques at gold mines and habitat destruction result in animal mortality, increased sedimentation in surface water from runoff and wind erosion, decreased air quality due to particulates. Disturbance related invasion of non-native species. Decreased water availability for aquatic systems/species.	Effects listed here are merely the direct and indirect impacts of the actual mining operations and are greatly compounded by infrastructure development for access.	X		
Sand & gravel quarrying	Ecoregion - Based Conservation in the Mojave Desert; J. E. Lovich and D. Bainbridge 1999; Clark and Hothem 1991; Henny et al. 1994; Wilshire 1983; Mojave Desert Network Vital Signs Monitoring Plan	Habitat loss, animal mortality, wind erosion , air quality degradation due to particulates, soil erosion, disturbance and deposition, ground and surface water contamination.	All conservation elements adjacent to and within extraction operations, all hydrologically connected aquatic systems.	Increased sedimentation in surface water from runoff and wind erosion. Decreased air quality due to particulates. Disturbance related invasion of non-native species.	Effects listed here are merely the direct and indirect impacts of the actual mining operations and are greatly compounded by infrastructure development for access.	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Renewable energy development								
Wind	BLM CDD 2010b; BLM Nevada 2010; CEC 2010c; Barrios & Rodriguez 2004; Drewitt & Langston 2006; CA Orloff & Flannery 1992; Osborn et al 2000	Habitat destruction, bird mortality has been documented, but effect vary greatly according to the siting of the facility and type of technology used.	All CE in construction area. Bird species.		Roads, transmission lines, invasive species	X	X	
Solar	BLM 2009; BLM CDD 2010a; BLM Nevada 2010; CEC 2010b; Revkin 2009; Wang 2009 Hunter et al 1987 Baechler & Lee 1991; Mihlmester et al. 1980 Beamish 2009	Habitat destruction due to clearing and leveling of the site Other potential environmental impacts of solar thermal receivers include: the accidental or emergency release of toxic chemicals used in the heat transfer system; bird collisions with a heliostat and incineration of both birds and insects if they fly into the high temperature portion of the beams; and--if one of the heliostats did not track properly but focused its high temperature beam on humans, other animals, or flammable materials--burns, retinal damage, and fires Concern about water usage in thermal (steam) solar plants have been raised	All CE in construction area.		Roads, transmission lines, invasive species, water drawdown	X	X	
Geothermal	CEC 2010a	Habitat destruction at site (similar to urban development). Areas have been identified with geothermal potential (Long Valley, Mono Lake, Randsburg) and the Haiwee/ Coso Hot Springs (Inyo County) have an active production sites as well as 22,400 acres up for lease (BLM California, 2010).	All CE in construction area.		Roads, transmission lines, invasive species	X	X	
Military Constrained Areas								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Military use areas	Demarais 1999; Milchunas et al 2000; Van Donk et al 2003 Steiger and Webb 2000; Prose 1985 DOE 1996; Berry et al 2006 Krzysik 1997	Off-road mechanized and artillery training activities reduce vegetation cover, disturb crusts, and degrade soils, making the land more vulnerable to wind erosion; perennial vegetation is negatively impacted; pollution and contamination from hazardous substances is an issue on some bases	All ecological systems, desert tortoise	Intense disturbances including tank maneuvers, bombing, explosives testing adversely affect desert tortoise; Deaths from anthropogenic sources were significantly correlated with surface disturbances, trash, military ordnance, and proximity to offices and paved roads—typical characteristics of military training areas		X		
Conflict-of-use areas	Pepper et al 2003; Weisenberger et al 1996); (Krausman et al 1998; Ellis et al 1991)	Low level aerial activity from military operations generates noise which has been shown to stress some wildlife butbut not always and not consistantly. Some species such as mountain sheep and prairie falcons have quickly habituated to noise				X		
Areas of moratoria on LU planning	Danelski 2010	DOD has objected to wind farms near military reservations due to turbines' interference with radar and flight operations; LU planning is effectively halted in areas slated for base expansion				X		
Potential military expansion areas	Danelski 2008; USFWS 2003	The expansion of the Ft Irwin and Twenty-nine Palms military reserves has the potential to negatively impact resources.	desert tortoise, lane mountain milk-vetch, desert bighorn sheep, desert cymopterus (USFWS, 2003).			X		
Military Use & DOE constrained areas (installations & off installations)		DOD and DOE constraints vary widely according to the managing department and branch of service.				X		
Main base activity/mission activity	Prose & Metzger 1985; DOE 1996).	Main base activities have persistent impacts similar to civilian urban development. Some military sites in the region have been found to have dangerous contaminants and while effects on humans are well known, effects on wildlife are unknown			Urbanization, roads, transmission corridors, ROW	X		
Air and Water Quality								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Fugitive dust	Neff et al 2008; Sharifi 1997; Reid et al. 1994; Sharifi 1997; Blank et al 1999; Reheis 1997; Saint Amand et al 1986	Surface dust directly impacts physiology of Mojave desert shrubs, direct effect of dust emissions on the respiratory systems of humans	All ecological systems, cryptogrammic soils, surface water, plant and animal species intolerant to toxic elements of pollution,	Negative responses by sensitive species, water quality degradation.	Off-road vehicle use, exploration and development of energy resources, pipelines, transmission lines, increased use of existing dirt roads facilitates increased dusting and leads to decreased plant biomass and cover; water diversions or the pumping of water from shallow lakes	X	X	
Air pollution	Lovich & Bainbridge 1999	Ozone levels in the Mojave Desert can exceed 100 parts per billion (ppb) or more when offshore wind transports atmospheric pollutants from the Los Angeles Basin (Thompson, 1984). This causes visibility degradation in an area historically distinguished by extraordinary visibility (Lovich & Bainbridge, 1999). Other effects include dry fall of particulates rich in N, plant and cryptogrammic soil damage from ozone and SO_2 . Water quality degradation, nutrient cycling alterations.	All ecological systems, cryptogrammic soils, surface water, plant and animal species intolerant to toxic elements of pollution.	Some annual grasses *(Camissonia* spp. and *Cryptantha* spp.) are sensitive to ozone and sulphur dioxide as well as perennial shrubs, *Atriplex humenelytra* (Fisher, 1978) and *Larrea tridentata* (Thompson, 1980). Responses by sensitive species include leaf injury, reduced growth, decreased photosynthetic rates and water use, and mortality. Water quality degradation as a result of acid rain deposition and airborne contaminants. (Thompson et al.1980, Fisher 1978). Dry fall deposition and enrichment of soil with nitrogen favors many exotic species. Responses of cryptogrammic soils to SO_2 and ozone include increased electrolyte leakage, chlorophyll degradation, and reduced nitrogen fixation (Belnap 1991).		X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Atmospheric Deposition	Fenn et al. 2003; Hageman et al. 2006; Schuster et al. 2002	Acidification of soils and water altering soil biological systems and root dynamics; nutrient (N, S) enrichment altering primary producting and inter-species plant competition; pesticide contamination (and bioaccumulation) in food webs; mercury contamination of top predators leading to reproductive and behavioral degradation	All ecological systems, cryptogrammic soils, surface water, plant and animal species intolerant to toxic elements of pollution.	See under "ecological effects"	Affected by climate change impacts that alter precipitation form and amounts and alter fog/mist deposition as well. Also affected by proximity of air contamination sources	X	X	
Refuse management	Lee G. F. and Jones-Lee A. 2005.	Degradation of ground water, methane and volatile organic compound migration toxic to plants and animals, increased road traffic, dust and windblown litter.	All nearby ecological systems, particularly aquatic systems fed by ground water with hydrologic connections to landfills.	Decomposing refuse produces toxic compounds which are often leached into adjacent aquifers linked to aquatic systems which can lead to species mortality. Construction related to landfills (roads, impoundments) results in 100% impact on CE's and significant impact on those adjacent.		X	X	
Hydrologic Alteration								
Groundwater withdrawals	Deacon et al. 2007	Reduce extent of perennial stream flows (gaining stream reaches), increase extent of dry streambeds (losing stream reaches), lower water levels and alter hydrologic regime of springs and seeps; alter alluvial soil moisture regimes in riparian zones.	Potentially specific lower foothill and basin streams, springs, seeps, depending on what aquifers are involved and proximity to groundwater extraction sites.	Altered hydrology leads to degradation of habitat and reduced availability and/or suitability of water bodies for ecosystem support.	Effects can be exacerbated by climate change, altered land cover and altered land-use that result in altered aquifer recharge; and by stream incision that drops water table levels along alluvial (riparian) zones.	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Altered surface flow connectivity (dams, alterations to habitat that make stream reaches unsuitable for species movement)	Deacon et al. 2007	Barriers to movement of aquatic fauna and transport of riparian plant propagules can reduce ability of streams to recolonize reaches following disturbance, and prevent aquatic animals from completing life-cycle changes	Potentially all stream/river networks subject to dams, diversions, or dry reaches	Same as "ecological effects"	Effects can be exacerbated by other CA that result in presence of dry stream or river reaches, that also act as barriers to biotic movement	X	X	
Altered surface flow (flood control, diversions etc)	Deacon et al. 2007	Altered stream and river flows caused by water diversions and flow manipulation (e.g., storage and release operations) result in diverse ecological consequences that become more severe the greater the degree of alteration of key components of the flow regime (magnitude, frequency, timing, duration of ecological flow components)	All flowing-water systems and any lakes or wetlands for which stream/river inflows determine the hydrologic regime; these are not common in this ecoregion	Same as "ecological effects"	Effects can be exacerbated by groundwater withdrawals, climate change, altered land cover and altered land-use that result in altered watershed rainfall, runoff, infiltration, and detention characteristics	X	X	
Recreation								
Land-based	Adams & McCool 2009	The ecological consequences of ORVs range from soil compaction and erosion, noise, air, and water pollution directly, indirectly and direct damage to vegetation and wildlife, habitat fragmentation, displacement of sensitive species, introduction and distribution of invasive species, and provide extensive access to legal hunting and illegal poaching of wildlife,	All ecological systems where recreation occurs, rare and sensitve native species, surface water, soils	Wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction (NV SWAP).	Urban populations	X	X	
Water-based	WAPT 2006	Motorized recreation (watercraft) (WAPT 2006))	Lakes and Reservoirs, fish, other aquatic elements	Wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction (NV SWAP).	Urban populations	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Dispersed recreation	Reed & Merenlender 2008	Hiking, biking, and horseback riding, especially when combined with the presence of domestic dogs caused shift in the composition of the carnivore community (Reed & Merenlender 2008).	Carnivore Communities (bobcat, coyote, fox)	Lower species richiness & lower abundance				
Climate Change								
Temperature Change	BLM 2008; Breshears et al. 2009; Dale et al. 2001; Epps et al. 2004; Lenart et al. 2007; Maurer et al. 2007; Parmesan and Yohe 2003; Seager et al. 2007; Thomas et al. 2004; USGCRP 2009; Smith et al. 2000	Range shifts among plants, animals; Increased evaporation and transpiration leading to declining soil moisture and increased drought stress in plants; lower snowpack and earlier snowmelt will both lead to changes in hydrological patterns	All ecological systems, species.	Species declines, sedimentation, species invasions, disease; range shifts among plants, animals; insect infestations in pine and mixed- conifer forests	Climate change stress across the Mojave Basin is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts; climate change, invasive species, wildfire, and native species decline has already developed in much of the southwestern U.S. and is expected to continue to worsen	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Precipitation Change	BLM 2008; Breshears et al. 2009; Dale et al. 2001; Epps et al. 2004; Lenart et al. 2007; Maurer et al. 2007; Parmesan and Yohe 2003; Seager et al. 2007; Thomas et al. 2004; USGCRP 2009; Smith et al. 2000	The Southwest is expected to become drier, however, even with some seasonal increases in precipitation; precipitation is expected to increasingly fall as rain instead of snow; intensified water cycle, there is an increased likelihood of flooding	All ecological systems, species.	species declines, sedimentation, species invasions, disease; range shifts among plants, animals;insect infestations in pine and mixed- conifer forests	Climate change stress across the Mojave Basin is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts; climate change, invasive species, wildfire, and native species decline has already developed in much of the southwestern U.S. and is expected to continue to worsen	X	X	
Invasive Species								
Terrestrial Invasive Species								
Star thistle (*Centaurea melitensis)*	Marshall R.M et al. 2001;	Competes with and displaces native plants; alters soil ecology	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Competes for rainfall, nutrients and microhabitats diminishing resources for native species	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Cheatgrass (*Bromus tectorum*)	Marshall R.M et al. 2001; J. E. Lovich and D. Bainbridge 1999	Increased fuel continuity, fire frequency, and fire intensity, competes with and displaces native plant species, alters alpha and beta diversity, alters soil ecology	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Increased fire duration and intensity may result in shrub mortality. Competes for rainfall, nutrients and microhabitats diminishing resources for native species	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Filaree (*Erodium cicutarium*)	Marshall R.M et al. 2001; J. E. Lovich and D. Bainbridge 1999	Reduction in native plant populations	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Competes for rainfall, nutrients and microhabitats diminishing resources for native species	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Red Brome (*Bromus rubens*)	Marshall R.M et al. 2001; J. E. Lovich and D. Bainbridge 1999	Increased fuel continuity, fire frequency, and fire intensity Reduction in native plant populations	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Increased fire duration and intensity may result in shrub mortality. Competes for rainfall, nutrients and microhabitats diminishing resources for native species	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Russian thistle (*Salsola iberica*)	Marshall R.M et al. 2001; J. E. Lovich and D. Bainbridge 1999	Competes with and displaces native plants. Negative allelopathic effects on native species	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Competes for rainfall, nutrients and microhabitats diminishing resources for native species May release chemicals toxic to native species into soil	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Split grass (*Schismus* spp.)	Marshall R.M et al. 2001; J. E. Lovich and D. Bainbridge 1999	Increased fuel continuity, fire frequency, and fire intensity, competes with and displaces native plants	Sonora-Mojave Creosote bush-White Bursage Desert Scrub, Mojave Mid-Elevation Mixed Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Sonoran Mid-Elevation Desert Scrub	Increased fire duration and intensity may result in shrub mortality. Competes for rainfall, nutrients and microhabitats diminishing resources for native species	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Tamarisk (*Tamarix spp.*)	Marshall R.M et al. 2007	Changes fire size and frequency; competes with and displaces native plants; lowers native species richness and density; alters soil ecology; alters species composition; alters alpha & beta diversity; alters geomorphological processes and hydrology	North American Warm Desert Lower Montane Riparian Woodland and Shrubland/Stream, North American Warm Desert Riparian Woodland and Shrubland/Stream, North American Warm Desert Riparian Mesquite Bosque/Stream, Main Stem River	Population reduction of native plant species, negative impacts on soil ecology, negative impacts on hydrologic processes	Disturbances such as exotic ungulate grazing or development promote invasion	X	X	
Saharan mustard (*Brassica tournefortii*)	AMT suggestion workshop 1, CAL-IPC 2010							

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Crimson fountain grass (*Pennisetum setaceum*)	AMT suggestion workshop 1, CAL-IPC 2010							
Camelthorn (*Alhagi maurorum*)	AMT suggestion workshop 1, CAL-IPC 2010							
Perennial pepperweed, white top (*Lepidium latifolium*)	AMT suggestion workshop 1, CAL-IPC 2010							
Weeping love grass (*Eragrostis curvula*)	AMT suggestion workshop 1, Yoshioka et al. 2009							
Buffelgrass (*Pennisetum ciliare*)	AMT suggestion workshop 1, Sands et al. 2009							
Date Palm (*Phoenix dactylifera*)	AMT suggestion workshop 1, Stone et al. 1992							
Russian Knapweed (*Acroptilon repens*)	AMT suggestion workshop 1, Arizona Invasive Plant Working Group 2005							
Aquatic Invasive Species								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Didymosphenia gemenata (Didymo, rock snot)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Eliminates habitat for majority of native benthic taxa, reduces biodiversity, alters stream hydraulics	Coldwater stream components of Montane aquatic	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature and hydrology	X	X	
Aquatic viral, bacterial, and other pathogenic and parasitic organisms	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Infections of native fauna can reduce population viabilities resulting in alterations to entire food webs and ecological patterns; potential of specific aquatic invasive fauna to act as carriers of parasitic and pathogenic organisms is noted in individual invasive species entries.	See listings of individual aquatic invasive carrier species.	See under "ecological effects"	Exacerbates effects caused directly by presence of the carrier organisms in an aquatic ecosystem, and can spread more widely than initial hosts/carriers depending on ability of the parasite or pathogen to infect other species	X	X	
Apple snails (Pomacea sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Compete with natives, alters food webs, potential disease vector	Springs, low-velocity streams and rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
European Ear Snail (Radix auricularia)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Compete with natives, alters food webs, potential disease vector	Lakes, springs, slow-moving rivers with mud bottoms	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature, sedimentation and hydrology	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Red-rim melania (Melanoides tuberculatus)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Competes with natives, alters food webs, potential disease vector; see also Benson 2010	Warm water streams; tolerates brackish and low-DO waters	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	X	X	
New Zealand mudsnail (Potamopyrus antipodarum)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Competes with natives, alters food webs, potential disease vector	Streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Chinese mystery snail *(Cipangopaludina chinensis malleata)*	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Competes with natives, alters food webs, potential disease vector	Lakes, springs, slow-moving rivers with mud bottoms	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Quagga mussel (Dreissena sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupts primary and secondary production, alters food webs and water chemistry, indirect effects, trophic cascades	Warm-water lakes, springs, slow-moving rivers	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	X	X	
Zebra mussel (Dreissena sp)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupts primary and secondary production, alters food webs, indirect effects, trophic cascades	Lakes, springs, slow-moving rivers	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Asian clam (Corbicula fluminea)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alters food webs, indirect effects, trophic cascades	Streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Bullfrog (*Bufo catesbiana)*	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alters food webs, indirect effects, trophic cascades	Lakes, wetlands, springs	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
African clawed frog (*Xenopus laevis*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alters food webs, indirect effects, trophic cascades	Lakes, wetlands, springs	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Crayfish spp.	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupt primary and secondary production, alter food webs, indirect effects, trophic cascades	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Mollies and guppies (*Poecilia* sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Unknown	See under "ecological effects"	Unknown	X	X	
Tilapia (*Oreochromis* sp)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Gizzard shad (*Dorosoma cepedianum*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	
Asian or European carp (Family *Cyprinidae*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	X	X	

Appendix 4a. Master Candidate Conservation Element List for Species in the Mojave Basin and Range Ecoregion using criteria a-b.

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Amphibians	Inyo Mountains Salamander	*Batrachoseps campi*	G2		No	CA	19	Yes
A	Amphibians	Kern Plateau Salamander	*Batrachoseps robustus*	G2		No	CA	10	No
A	Amphibians	Tehachapi Slender Salamander	*Batrachoseps stebbinsi*	G2		Yes	CA	7	No
A	Amphibians	Western Toad	*Bufo boreas*	G4		Yes	AK, MT, OR, UT, WA		Yes
A	Amphibians	Arroyo Toad	*Bufo californicus*	G2	LE	No	CA	5	Yes
A	Amphibians	Great Plains Toad	*Bufo cognatus*	G5		Yes	IA, MO, NV, UT, WY		Yes
A	Amphibians	Black Toad	*Bufo exsul*	G1		Yes	CA	1	Yes
A	Amphibians	Arizona Toad	*Bufo microscaphus*	G3		Yes	AZ, NM, NV, UT	101	Yes
A	Amphibians	Amargosa Toad	*Bufo nelsoni*	G2		Yes	NV	23	No
A	Amphibians	Mount Lyell Salamander	*Hydromantes platycephalus*	G3		No	CA	3	No
A	Amphibians	Owens Valley Web-toed Salamander	*Hydromantes sp. 1*	G1		No	CA	2	No
A	Amphibians	California Red-legged Frog	*Rana draytonii*	G2	PS:LT	No	CA	2	Yes
A	Amphibians	Southern Mountain Yellow-legged Frog	*Rana muscosa*	G2	PS:LE,C	No	CA	21	No
A	Amphibians	Relict Leopard Frog	*Rana onca*	G1	PS	Yes	AZ, NV, UT	17	Yes
A	Amphibians	Northern Leopard Frog	*Rana pipiens*	G5	PS:LT	Yes	AZ, CA, CO, CT, ID, IN, KY, MA, MI, MO, MT, NH, NM, NV, OR, PA, RI, UT, WA, WV, WY	15	Yes
A	Amphibians	Sierra Nevada Yellow-legged Frog	*Rana sierrae*	G1	PS	No	NV	2	No
A	Amphibians	Yavapai Leopard Frog	*Rana yavapaiensis*	G4	PS	Yes	AZ, CA, NM		Yes
A	Amphibians	Western Spadefoot	*Spea hammondii*	G3	PS:LE	No	CA	5	No
A	Ants, Wasps, and Bees	Mojave Gypsum Bee	*Andrena balsamorhizae*	G2	PS	No		25	No
A	Ants, Wasps, and Bees	A Chrysidid Wasp	*Ceratochrysis gracilis*	G1	LE,XN	No		1	No
A	Ants, Wasps, and Bees	Menke's Chrysidid Wasp	*Ceratochrysis menkei*	G1	PS	No		1	No
A	Ants, Wasps, and Bees	Redheaded Sphecid Wasp	*Eucerceris ruficeps*	G2	PS	No		1	No
A	Ants, Wasps, and Bees	An Ant	*Lasius nevadensis*	G1	PS:LE	No		1	No
A	Ants, Wasps, and Bees	Red-tailed Blazing Star Bee	*Megandrena mentzeliae*	G2	PS:LE	No		39	No
A	Ants, Wasps, and Bees	An Ant	*Neivamyrmex nyensis*	G1	PS	No		1	No
A	Ants, Wasps, and Bees	A Cleptoparasitic Bee	*Paranomada californica*	G1	PS	No		2	No
A	Ants, Wasps, and Bees	Borrego Parnopes Chrysidid Wasp	*Parnopes borregoensis*	G1	PS	No		1	No
A	Ants, Wasps, and Bees	Big-headed Perdita	*Perdita cephalotes*	G2	LE	No		3	No
A	Ants, Wasps, and Bees	Mojave Poppy Bee	*Perdita meconis*	G2	PS	No		17	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Ants, Wasps, and Bees	A Cleptoparasitic Bee	*Rhopalolemma robertsi*	G1	LE	No		1	No
A	Birds	Cooper's Hawk	*Accipiter cooperii*	G5	PS	Yes	CA, CT, DE, MI, NC, NE, NH, NJ, NY, VT, WV	8	No
A	Birds	Northern Goshawk	*Accipiter gentilis*	G5	PS	Yes	AK, AK, CA, CO, CT, MD, MI, MN, NH, NJ, NM, NV, NY, OR, PA, RI, SD, UT, VT, WA, WI, WV, WY	6	No
A	Birds	Tricolored Blackbird	*Agelaius tricolor*	G2	PS	Yes	CA, NV, WA	10	Yes
A	Birds	Grasshopper Sparrow	*Ammodramus savannarum*	G5		Yes	AR, AZ, CA, CT, DC, DE, FL, GA, IA, ID, IL, KS, KY, LA, MA, MD, ME, MI, MN, MS, NC, ND, NH, NJ, NM, NY, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV, WY	1	No
A	Birds	Golden Eagle	*Aquila chrysaetos*	G5	PS	Yes	AK, CA, CO, KS, MD, ME, ND, NE, NH, NM, NY, PA, TN, TX, WA	4	Yes
A	Birds	Short-eared Owl	*Asio flammeus*	G5	PS	Yes	AK, AL, AR, CA, CO, CT, DE, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, ND, NE, NJ, NV, NY, OK, OR, PA, RI, TN, TX, UT, VT, WA, WI, WV, WY	2	Yes
A	Birds	Long-eared Owl	*Asio otus*	G5	PS:LT,XN	Yes	CA, CT, DE, IA, KY, MA, MD, ME, MI, MO, NE, NJ, NY, PA, RI, VT, WV	9	Yes
A	Birds	Burrowing Owl	*Athene cunicularia*	G4	PS	Yes	CA, CO, IA, ID, KS, MN, MT, ND, NE, NM, OK, SD, TX, UT, WA, WY	180	Yes
A	Birds	Ferruginous Hawk	*Buteo regalis*	G4		Yes	AZ, CA, CO, ID, KS, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WY	15	Yes
A	Birds	Swainson's Hawk	*Buteo swainsoni*	G5		Yes	AK, CA, CO, IA, ID, IL, KS, MN, MO, ND, NE, NV, OK, OR, TX, WA, WY	15	No
A	Birds	Common Black-Hawk	*Buteogallus anthracinus*	G4		Yes	AZ, NM, TX	4	No
A	Birds	Green Heron	*Butorides virescens*	G5		Yes	CT, MA, MI, NJ, SC, VA, WA	2	No
A	Birds	Costa's Hummingbird	*Calypte costae*	G5		Yes	CA, NM, NV	7	Yes
A	Birds	Northern Cardinal	*Cardinalis cardinalis*	G5		Yes	CA	2	No
A	Birds	Turkey Vulture	*Cathartes aura*	G5		Yes	WA	3	No
A	Birds	Western Snowy Plover	*Charadrius alexandrinus nivosus*	T3		Yes	AZ, CA, CO, NV, OR, WA	5	Yes
A	Birds	Mountain Plover	*Charadrius montanus*	G3	PS	Yes	AZ, CA, CO, KS, MT, NE, NM, OK, TX, UT, WY	7	No
A	Birds	Lesser Nighthawk	*Chordeiles acutipennis*	G5	PS	Yes		7	No
A	Birds	Northern Harrier	*Circus cyaneus*	G5	PS:LE	Yes	AK, AL, AR, AZ, CA, CO, CT, DE, IA, IL, IN, KY, LA, MA, MD, MI, MN, MO, NC, ND, NE, NH, NJ, NM, NY, PA, RI, TN, TX, VA, VT, WI, WV	1	Yes
A	Birds	Evening Grosbeak	*Coccothraustes vespertinus*	G5		Yes	AZ, CO, MI	1	No
A	Birds	Yellow-billed Cuckoo	*Coccyzus americanus*	G5		Yes	AR, CO, CT, IA, ID, IL, LA, MI, NC, NE, NJ, NM, RI, TN, TX, UT, VA, WA, WI, WY	10	No
A	Birds	Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	T3	C	Yes	AZ, CA, NV	45	Yes
A	Birds	Inca Dove	*Columbina inca*	G5		Yes		1	No
A	Birds	Cape May Warbler	*Dendroica tigrina*	G5		Yes	CT, ME, MN, NY	1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Birds	Bobolink	*Dolichonyx oryzivorus*	G5		Yes	CO, CT, DC, DE, IA, IL, KS, KY, MD, ME, MI, MN, NC, ND, NJ, NV, NY, OH, OR, PA, RI, UT, VT, WA, WI, WV, WY	1	No
A	Birds	Willow Flycatcher	*Empidonax traillii*	G5		Yes	AR, CA, CT, DE, IA, KY, MA, MD, ME, MN, NC, NJ, NY, OK, PA, RI, VA, WA, WI, WY	3	No
A	Birds	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	T1	LE	Yes	AZ, CA, CO, NM, NV, UT	48	Yes
A	Birds	Merlin	*Falco columbarius*	G5		Yes	AK, AK, CA, FL, ID, MI, NE, TX, WA, WY	1	No
A	Birds	Prairie Falcon	*Falco mexicanus*	G5		Yes	CA, CO, ND, NE, OK, TX, WA	146	No
A	Birds	Peregrine Falcon	*Falco peregrinus*	G4		Yes	AK, CT, DE, FL, IA, ID, IL, IN, KS, KY, MA, ME, MI, MN, MO, NC, ND, NE, NH, NJ, NM, NV, NY, OK, PA, RI, SC, SD, TN, UT, VA, VT, WA, WI, WV, WY	52	Yes
A	Birds	Common Moorhen	*Gallinula chloropus*	G5		Yes	AR, CT, IA, IL, IN, KY, MA, MD, ME, MI, MN, MO, NC, NH, OH, PA, RI, WV	2	No
A	Birds	Greater Roadrunner	*Geococcyx californianus*	G5		Yes	MO	2	No
A	Birds	Common Yellowthroat	*Geothlypis trichas*	G5		Yes	RI, TX	10	No
A	Birds	California Condor	*Gymnogyps californianus*	G1		Yes	AZ, CA, UT	2	No
A	Birds	Bald Eagle	*Haliaeetus leucocephalus*	G5		Yes	AK, AK, AR, AZ, CA, CO, CT, DC, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY	17	No
A	Birds	Yellow-breasted Chat	*Icteria virens*	G5		Yes	CA, CT, DE, IA, IL, MI, NE, NJ, NY, OR, PA, RI, VA, WA	24	Yes
A	Birds	Hooded Oriole	*Icterus cucullatus*	G5		Yes	NM, TX	3	No
A	Birds	Scott's Oriole	*Icterus parisorum*	G5		Yes	NV, TX, WY		Yes
A	Birds	Mississippi Kite	*Ictinia mississippiensis*	G5		Yes	AR, AZ, FL, IL, IN, KS, KY, MO, NC, NE, TN, TX	1	No
A	Birds	Least Bittern	*Ixobrychus exilis*	G5		Yes	AL, AR, CA, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MS, NC, NE, NH, NJ, NY, PA, RI, SC, TN, TX, VA, VT, WV	3	No
A	Birds	Western Least Bittern	*Ixobrychus exilis hesperis*	T3		Yes	NV	1	Yes
A	Birds	Loggerhead Shrike	*Lanius ludovicianus*	G4		Yes	CA, CO, DE, FL, IA, IL, IN, KS, KY, LA, MD, ME, MN, MO, MS, NC, ND, NE, NJ, NM, NV, NY, OK, OR, PA, SC, TN, TX, VA, WA, WI	4	Yes
A	Birds	Acorn Woodpecker	*Melanerpes formicivorus*	G5		Yes	OR, WA	1	No
A	Birds	Lewis's Woodpecker	*Melanerpes lewis*	G4		Yes	AZ, CA, CO, ID, KS, NE, NM, NV, OK, OR, SD, UT, WA, WY	2	No
A	Birds	Gila Woodpecker	*Melanerpes uropygialis*	G5		Yes	CA, NM	6	No
A	Birds	Elf Owl	*Micrathene whitneyi*	G5		Yes	CA, NM, TX	6	No
A	Birds	Wood Stork	*Mycteria americana*	G4		Yes	AL, AR, CA, FL, GA, LA, MS, NC, OK, SC, TX	1	No
A	Birds	Brown-crested Flycatcher	*Myiarchus tyrannulus*	G5		Yes	CA	7	Yes
A	Birds	Painted Redstart	*Myioborus pictus*	G5		Yes	NM	1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Birds	Kentucky Warbler	*Oporornis formosus*	G5		Yes	AL, AR, DC, DE, FL, IA, IL, KS, KY, LA, MD, MI, MS, NC, NE, NJ, NY, OK, PA, SC, TN, TX, VA, WI, WV	1	No
A	Birds	Mountain Quail	*Oreortyx pictus*	G5		Yes	ID, NV, OR, WA	1	No
A	Birds	Blue Grosbeak	*Passerina caerulea*	G5		Yes	ID	22	Yes
A	Birds	Band-tailed Pigeon	*Patagioenas fasciata*	G4		Yes	AK, CO, NM, OR, TX, UT, WA	16	No
A	Birds	American White Pelican	*Pelecanus erythrorhynchos*	G4		Yes	AR, CA, CO, DE, IA, ID, KS, KY, MI, MN, MS, ND, NE, NV, OR, SD, TX, UT, WA, WY	9	No
A	Birds	Phainopepla	*Phainopepla nitens*	G5		Yes	NV, TX	28	Yes
A	Birds	Ladder-backed Woodpecker	*Picoides scalaris*	G5		Yes	KS, TX	2	No
A	Birds	Abert's Towhee	*Pipilo aberti*	G3		Yes	CA, NM, NV, UT	12	Yes
A	Birds	Inyo California Towhee	*Pipilo crissalis eremophilus*	T1	LT	Yes	CA	74	Yes
A	Birds	Hepatic Tanager	*Piranga flava*	G5		Yes	CA	8	Yes
A	Birds	Summer Tanager	*Piranga rubra*	G5		Yes	CA, MD, NE, NJ, PA	15	Yes
A	Birds	White-faced Ibis	*Plegadis chihi*	G5		Yes	CA, CO, ID, NE, NM, NV, TX, WY	2	No
A	Birds	Black-tailed Gnatcatcher	*Polioptila melanura*	G5		Yes	CA, TX	8	No
A	Birds	Purple Martin	*Progne subis*	G5		Yes	AZ, CA, CO, CT, ME, MI, NH, OR, RI, VT, WA	1	No
A	Birds	Vermilion Flycatcher	*Pyrocephalus rubinus*	G5		Yes	CA	14	Yes
A	Birds	Yuma Clapper Rail	*Rallus longirostris yumanensis*	T3	LE	Yes	AZ, CA, NV	19	Yes
A	Birds	American Avocet	*Recurvirostra americana*	G5		Yes	AR, AZ, FL, IA, ID, KS, MN, ND, NE, NV, SC, TX, UT, WA	6	No
A	Birds	Black Phoebe	*Sayornis nigricans*	G5		Yes	NV	3	No
A	Birds	Williamson's Sapsucker	*Sphyrapicus thyroideus*	G5		Yes	CO, NM, UT, WA	1	No
A	Birds	Least Tern	*Sternula antillarum*	G4		Yes	CO, CT, DE, FL, GA, IA, IL, IN, KS, MA, MD, ME, MS, NC, ND, NH, NJ, NM, NY, RI, SC, TX, VA	2	No
A	Birds	Spotted Owl	*Strix occidentalis*	G3		Yes	TX	7	No
A	Birds	Mexican Spotted Owl	*Strix occidentalis lucida*	T3		Yes	AZ, CO, NM, UT		Yes
A	Birds	Bendire's Thrasher	*Toxostoma bendirei*	G4		Yes	CA, NM, NV, UT	57	Yes
A	Birds	Crissal Thrasher	*Toxostoma crissale*	G5		Yes	CA, NV, TX, UT	20	Yes
A	Birds	Le Conte's Thrasher	*Toxostoma lecontei*	G4		Yes	AZ, CA, NV	157	Yes
A	Birds	Cassin's Kingbird	*Tyrannus vociferans*	G5		Yes	NE, TX	1	No
A	Birds	Lucy's Warbler	*Vermivora luciae*	G5		Yes	CA, NM, NV, TX, UT	1	Yes
A	Birds	Virginia's Warbler	*Vermivora virginiae*	G5		Yes	CA, CO, ID, NV, TX, UT	4	No
A	Birds	Bell's Vireo	*Vireo bellii*	G5		Yes	AR, IA, IL, KS, KY, LA, MN, NE, NM, OK, TN, TX, UT, WI	3	No
A	Birds	Arizona Bell's Vireo	*Vireo bellii arizonae*	T4		Yes	CA, NV	8	Yes
A	Birds	Least Bell's Vireo	*Vireo bellii pusillus*	T2	LE	Yes	CA	14	Yes
A	Birds	Gray Vireo	*Vireo vicinior*	G4		Yes	CA, CO, NM, NV, TX, UT	28	Yes
A	Birds	White-winged Dove	*Zenaida asiatica*	G5		Yes		1	No
A	Butterflies and Skippers	Desert Green Hairstreak	*Callophrys comstocki*	G2		No		1	No

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A	Butterflies and Skippers	Mcneill's Saltbush Sootywing	*Hesperopsis gracielae*	G2		No		3	Yes
A	Butterflies and Skippers	San Emigdio Blue	*Plebulina emigdionis*	G2		No		5	No
A	Butterflies and Skippers	Carol's Fritillary	*Speyeria carolae*	G2		No		40	Yes
A	Butterflies and Skippers	Nokomis Fritillary	*Speyeria nokomis*	G3		No		2	No
A	Caddisflies	Denning's Cryptic Caddisfly	*Cryptochia denningi*	G1		No		1	No
A	Freshwater and Anadromous Fishes	Desert Sucker	*Catostomus clarkii*	G3		Yes		223	Yes
A	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*	T1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Meadow Valley Wash Desert Sucker	*Catostomus clarkii ssp. 2*	T2		Yes		6	Yes
A	Freshwater and Anadromous Fishes	Bluehead Sucker	*Catostomus discobolus*	G4		Yes		3	No
A	Freshwater and Anadromous Fishes	Flannelmouth Sucker	*Catostomus latipinnis*	G3		Yes		103	Yes
A	Freshwater and Anadromous Fishes	Santa Ana Sucker	*Catostomus santaanae*	G1	LT	No		2	No
A	Freshwater and Anadromous Fishes	White River Springfish	*Crenichthys baileyi baileyi*	T1	LE	Yes		2	Yes
A	Freshwater and Anadromous Fishes	Hiko White River Springfish	*Crenichthys baileyi grandis*	T1	LE	Yes			Yes
A	Freshwater and Anadromous Fishes	Moapa White River Springfish	*Crenichthys baileyi moapae*	T2		Yes		7	Yes
A	Freshwater and Anadromous Fishes	Devil's Hole Pupfish	*Cyprinodon diabolis*	G1	LE	Yes		4	No
A	Freshwater and Anadromous Fishes	Desert Pupfish	*Cyprinodon macularius*	G1	LE	Yes		3	No
A	Freshwater and Anadromous Fishes	Ash Meadows Pupfish	*Cyprinodon nevadensis mionectes*	T2	LE	Yes		17	No
A	Freshwater and Anadromous Fishes	Warm Springs Amargosa Pupfish	*Cyprinodon nevadensis pectoralis*	T1	LE	Yes		7	No
A	Freshwater and Anadromous Fishes	Owens River Pupfish	*Cyprinodon radiosus*	G1	LE	Yes		6	No
A	Freshwater and Anadromous Fishes	Cottonball Marsh Pupfish	*Cyprinodon salinus milleri*	T1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Pahrump Poolfish	*Empetrichthys latos latos*	T1		Yes		4	Yes
A	Freshwater and Anadromous Fishes	Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	T1	LE	Yes		3	No
A	Freshwater and Anadromous Fishes	Mohave Tui Chub	*Gila bicolor mohavensis*	T1	LE	Yes		7	Yes
A	Freshwater and Anadromous Fishes	Owens Tui Chub	*Gila bicolor snyderi*	T1	LE	Yes		3	No

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A	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*	G1	LE	Yes		4	No
A	Freshwater and Anadromous Fishes	Arroyo Chub	*Gila orcuttii*	G2		No		3	No
A	Freshwater and Anadromous Fishes	Roundtail Chub	*Gila robusta*	G3		Yes		21	No
A	Freshwater and Anadromous Fishes	A Roundtail Chub	*Gila robusta jordani*	T1	LE	Yes		2	Yes
A	Freshwater and Anadromous Fishes	Virgin River Chub	*Gila seminuda*	G1	LE	Yes		44	Yes
A	Freshwater and Anadromous Fishes	Virgin River Chub - Muddy River Population	*Gila seminuda pop. 2*	T1		Yes		9	No
A	Freshwater and Anadromous Fishes	Virgin Spinedace	*Lepidomeda mollispinis*	G1		Yes		148	Yes
A	Freshwater and Anadromous Fishes	Virgin River Spinedace	*Lepidomeda mollispinis mollispinis*	T1		Yes		4	No
A	Freshwater and Anadromous Fishes	Moapa Dace	*Moapa coriacea*	G1	LE	Yes		6	Yes
A	Freshwater and Anadromous Fishes	Bonneville Cutthroat Trout	*Oncorhynchus clarkii utah*	T4		Yes		5	No
A	Freshwater and Anadromous Fishes	Woundfin	*Plagopterus argentissimus*	G1	LE, XN	Yes		41	Yes
A	Freshwater and Anadromous Fishes	Colorado Pikeminnow	*Ptychocheilus lucius*	G1	LE, XN	Yes		1	No
A	Freshwater and Anadromous Fishes	Speckled Dace	*Rhinichthys osculus*	G5	PS	No		154	Yes
A	Freshwater and Anadromous Fishes	Moapa Speckled Dace	*Rhinichthys osculus moapae*	T1		Yes		4	No
A	Freshwater and Anadromous Fishes	Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*	T1	LE	Yes		10	No
A	Freshwater and Anadromous Fishes	Pahranagat Speckled Dace	*Rhinichthys osculus velifer*	T1		Yes		4	Yes
A	Freshwater and Anadromous Fishes	A Speckled Dace	*Rhinichthys sp. 3*	G1		No		3	No
A	Freshwater and Anadromous Fishes	Razorback Sucker	*Xyrauchen texanus*	G1	LE	Yes		14	Yes
A	Freshwater Snails	Badwater Snail	*Assiminea infima*	G1		No		5	Yes
A	Freshwater Snails	Robust Tryonia	*Ipnobius robustus*	G1		No		3	No
A	Freshwater Snails	Moapa Pebblesnail	*Pyrgulopsis avernalis*	G1		No		7	Yes
A	Freshwater Snails	Grand Wash Springsnail	*Pyrgulopsis bacchus*	G1		No			Yes
A	Freshwater Snails	A Freshwater Snail	*Pyrgulopsis carinifera*	G1		No		5	Yes
A	Freshwater Snails	Kingman Springsnail	*Pyrgulopsis conica*	G1		No			Yes
A	Freshwater Snails	Crystal Springsnail	*Pyrgulopsis crystalis*	G1		No		1	No
A	Freshwater Snails	Spring Mountains Pyrg	*Pyrgulopsis deaconi*	G1		No		5	Yes
A	Freshwater Snails	Desert Springsnail	*Pyrgulopsis deserta*	G2		Yes		4	Yes

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A	Freshwater Snails	Ash Meadows Pebblesnail	*Pyrgulopsis erythropoma*	G1		No		5	No
A	Freshwater Snails	Fairbanks Springsnail	*Pyrgulopsis fairbanksensis*	G1		No		1	No
A	Freshwater Snails	Corn Creek Pyrg	*Pyrgulopsis fausta*	G1		No		2	Yes
A	Freshwater Snails	Hubbs Pyrg	*Pyrgulopsis hubbsi*	G1		No			Yes
A	Freshwater Snails	Elongate-gland Springsnail	*Pyrgulopsis isolata*	G1		No		1	No
A	Freshwater Snails	Pahranagat Pebblesnail	*Pyrgulopsis merriami*	G1		No		1	Yes
A	Freshwater Snails	Oasis Valley Springsnail	*Pyrgulopsis micrococcus*	G3		No		18	Yes
A	Freshwater Snails	Distal-gland Springsnail	*Pyrgulopsis nanus*	G1		No		4	No
A	Freshwater Snails	Median-gland Springsnail	*Pyrgulopsis pisteri*	G1		No		3	No
A	Freshwater Snails	Southeast Nevada Pyrg	*Pyrgulopsis turbatrix*	G2		No		11	Yes
A	Freshwater Snails	Wong's Springsnail	*Pyrgulopsis wongi*	G2		No		24	Yes
A	Freshwater Snails	Sportinggoods Tryonia	*Tryonia angulata*	G1		No		3	No
A	Freshwater Snails	Grated Tryonia	*Tryonia clathrata*	G2		No		9	Yes
A	Freshwater Snails	Point of Rocks Tryonia	*Tryonia elata*	G1		No		2	No
A	Freshwater Snails	Minute Tryonia	*Tryonia ericae*	G1		No		2	No
A	Freshwater Snails	Grapevine Springs Elongate Tryonia	*Tryonia margae*	G1		No		2	Yes
A	Freshwater Snails	Grapevine Springs Squat Tryonia	*Tryonia rowlandsi*	G1		No		1	Yes
A	Freshwater Snails	Cottonball Marsh Tryonia	*Tryonia salina*	G1		No			Yes
A	Freshwater Snails	Amargosa Tryonia	*Tryonia variegata*	G2		No		16	No
A	Grasshoppers	Desert Monkey Grasshopper	*Psychomastax deserticola*	G1		No		2	No
A	Katydids and Crickets	Kelso Jerusalem Cricket	*Ammopelmatus kelsoensis*	G1		No		1	No
A	Katydids and Crickets	Kelso Giant Sand Treader Cricket	*Macrobaenetes kelsoensis*	G1		No		1	Yes
A	Katydids and Crickets	Coachella Giant Sand Treader Cricket	*Macrobaenetes valgum*	G1		No		5	No
A	Katydids and Crickets	Coachella Valley Jerusalem Cricket	*Stenopelmatus cahuilaensis*	G1		No		1	No
A	Mammals	Nelson's Antelope Squirrel	*Ammospermophilus nelsoni*	G2		Yes	CA	1	No
A	Mammals	Pallid Bat	*Antrozous pallidus*	G5		Yes	CA, KS, MT, OR, TX, WA, WY	77	Yes
A	Mammals	Pygmy Rabbit	*Brachylagus idahoensis*	G4		Yes	CA, ID, MT, NV, OR, UT, WA, WY	1	No
A	Mammals	Mexican Long-tongued Bat	*Choeronycteris mexicana*	G4		Yes	AZ, CA, NM	1	No
A	Mammals	Townsend's Big-eared Bat	*Corynorhinus townsendii*	G4		Yes	CA, ID, KS, MT, NE, NV, OR, SD, TX, UT, WY	124	Yes
A	Mammals	Pale Lump-nosed Bat	*Corynorhinus townsendii pallescens*	T4		Yes	CO, OK, WA		Yes
A	Mammals	Utah Prairie Dog	*Cynomys parvidens*	G1	LT	Yes	UT	28	No
A	Mammals	Merriam's Kangaroo Rat	*Dipodomys merriami*	G5	PS	No		9	No
A	Mammals	Stephens's Kangaroo Rat	*Dipodomys stephensi*	G2	LE	Yes	CA	4	No
A	Mammals	Spotted Bat	*Euderma maculatum*	G4		Yes	AZ, CA, CO, ID, MT, NM, NV, OR, TX, UT, WA, WY	29	Yes
A	Mammals	Greater Bonneted Bat	*Eumops perotis*	G5		Yes	CA	1	No
A	Mammals	California Bonneted Bat	*Eumops perotis californicus*	T4		Yes	AZ, TX	7	Yes
A	Mammals	Wolverine	*Gulo gulo*	G4		Yes	AK, CA, CO, ID, UT, WA, WY	7	No
A	Mammals	Allen's Big-eared Bat	*Idionycteris phyllotis*	G3		Yes	CO, NM, NV, UT	8	Yes
A	Mammals	Western Red Bat	*Lasiurus blossevillii*	G5		Yes	AZ, CA, NM, NV, UT	4	No

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A	Mammals	Hoary Bat	*Lasiurus cinereus*	G5	PS	No	CA, CT, DE, FL, IN, MA, MD, MI, MS, NC, NH, NJ, NV, NY, OR, PA, RI, VT, WA, WI, WV, WY	13	Yes
A	Mammals	Western Yellow Bat	*Lasiurus xanthinus*	G5		Yes	AZ, CA, NM, NV, TX	13	No
A	Mammals	Southwestern River Otter	*Lontra canadensis sonora*	T1		Yes	AZ, CA, NM	3	Yes
A	Mammals	Californian Leaf-nosed Bat	*Macrotus californicus*	G4		Yes	AZ, CA, NV	27	Yes
A	Mammals	Fisher - West Coast Distinct Population Segment	*Martes pennanti pop. 1*	T2	C	No	WA	2	No
A	Mammals	Desert Valley Kangaroo Mouse	*Microdipodops megacephalus albiventer*	T2		Yes	NV	2	No
A	Mammals	Amargosa Vole	*Microtus californicus scirpensis*	T1	LE	Yes	CA	7	No
A	Mammals	Pahranagat Valley Vole	*Microtus montanus fucosus*	T2		Yes	NV	4	Yes
A	Mammals	Ash Meadows Montane Vole	*Microtus montanus nevadensis*	TH		Yes		2	No
A	Mammals	Fringed Myotis	*Myotis thysanodes*	G4		Yes	CA, CO, ID, NE, NV, OR, TX, UT, WA, WY	32	Yes
A	Mammals	Palmer's Chipmunk	*Neotamias palmeri*	G2		Yes	NV	11	Yes
A	Mammals	Hidden Forest Chipmunk	*Neotamias umbrinus nevadensis*	TH		Yes	NV	1	No
A	Mammals	Big Free-tailed Bat	*Nyctinomops macrotis*	G5		Yes	AZ, CA, NV, TX, UT	10	Yes
A	Mammals	American Pika	*Ochotona princeps*	G5		Yes	NV, UT, WA	1	No
A	Mammals	Desert Bighorn Sheep	*Ovis canadensis nelsoni*	T4		Yes	CA, CA, NV	37	Yes
A	Mammals	Bighorn Sheep - Peninsular Ranges	*Ovis canadensis pop. 2*	T3	LE	Yes		2	No
A	Mammals	Sierra Nevada Bighorn Sheep	*Ovis canadensis sierrae*	T1	LE	Yes	CA, NV	3	Yes
A	Mammals	Mohave Ground Squirrel	*Spermophilus mohavensis*	G2		Yes	CA	298	Yes
A	Mammals	Palm Springs Round-tailed Ground Squirrel	*Spermophilus tereticaudus chlorus*	T2	C	No	CA	7	No
A	Mammals	Brazilian Free-tailed Bat	*Tadarida brasiliensis*	G5		Yes	AL, AZ, OK, TX	28	No
A	Mammals	Brown Bear	*Ursus arctos*	G4		Yes	AK, CO, ID, MT, UT, WA, WY	1	No
A	Mammals	Kit Fox	*Vulpes macrotis*	G4		Yes	CO, NV, OR, UT	15	Yes
A	Other Beetles	Aegialian Scarab Beetle	*Aegialia knighti*	G1		No		1	No
A	Other Beetles	Large Aegialian Scarab Beetle	*Aegialia magnifica*	G1		No		1	No
A	Other Beetles	Death Valley Agabus Diving Beetle	*Agabus rumppi*	G2		No		3	No
A	Other Beetles	Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	T2	LT	No		3	No
A	Other Beetles	Casey's June Beetle	*Dinacoma caseyi*	G1	PE	No		2	No
A	Other Beetles	Kelso Dune Glaresis Scarab Beetle	*Glaresis arenata*	G2		No		1	No
A	Other Beetles	Simple Hydroporus Diving Beetle	*Hydroporus simplex*	G1		No		1	No
A	Other Beetles	Furnace Creek Riffle Beetle	*Microcylloepus formicoideus*	G1		No		1	No
A	Other Beetles	Nelson's Miloderes Weevil	*Miloderes nelsoni*	G2		No		2	No
A	Other Beetles	Rulien's Miloderes Weevil	*Miloderes sp. 1*	G1		No		1	No
A	Other Beetles	Saline Valley Snow-front Scarab Beetle	*Polyphylla anteronivea*	G1		No		1	No
A	Other Beetles	Spotted Warner Valley Dunes Scarab Beetle	*Polyphylla avittata*	G2		No		2	No
A	Other Beetles	A Polyphyllan Scarab Beetle	*Polyphylla erratica*	G1		No		3	No
A	Other Beetles	Giuliani's Dune Scarab Beetle	*Pseudocotalpa giulianii*	G1		No		2	No

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A	Other Beetles		*Stenelmis lariversi*	G1		No		1	No
A	Other Beetles	Moapa Warm Springs Riffle Beetle	*Stenelmis moapa*	G1		No		1	No
A	Other Beetles	Brown-tassel Trigonoscuta Weevil	*Trigonoscuta brunnotesselata*	G1		No		1	No
A	Other Insects	Ash Meadows Naucorid	*Ambrysus amargosus*	G1	LT	No		2	No
A	Other Insects	Nevares Spring Naucorid Bug	*Ambrysus funebris*	G1	C	No		2	No
A	Other Insects	Saratoga Springs Belostoman Bug	*Belostoma saratogae*	G1		No		1	No
A	Other Insects	Lacewing or Ally	*Oliarces clara*	G2		No		2	No
A	Other Insects	Amargosa Naucorid Bug	*Pelocoris shoshone*	G2		No		4	No
A	Other Insects	A Naucorid Bug	*Usingerina moapensis*	G1		No		1	Yes
A	Reptiles	Zebra-tailed Lizard	*Callisaurus draconoides*	G5		Yes	UT	71	Yes
A	Reptiles	Southern Rubber Boa	*Charina umbratica*	G2		Yes	CA	27	No
A	Reptiles	Western Banded Gecko	*Coleonyx variegatus*	G5		Yes	NV, UT	31	Yes
A	Reptiles	Sidewinder	*Crotalus cerastes*	G5		Yes	UT	20	Yes
A	Reptiles	Speckled Rattlesnake	*Crotalus mitchellii*	G5		Yes	UT	6	Yes
A	Reptiles	Mohave Rattlesnake	*Crotalus scutulatus*	G5		Yes	UT	17	Yes
A	Reptiles	Desert Iguana	*Dipsosaurus dorsalis*	G5		Yes	NV, UT	2	Yes
A	Reptiles	Panamint Alligator Lizard	*Elgaria panamintina*	G2		No	CA	8	Yes
A	Reptiles	Desert Tortoise	*Gopherus agassizii*	G4	LT, SAT	Yes	AZ, AZ, CA, NV, UT	1366	No
A	Reptiles	Gila Monster	*Heloderma suspectum*	G4		Yes	NM, UT	47	No
A	Reptiles	Banded Gila Monster	*Heloderma suspectum cinctum*	T4		Yes	CA, NV	82	Yes
A	Reptiles	Sonoran Mountain Kingsnake	*Lampropeltis pyromelana*	G4		Yes	NM, NV, UT	7	No
A	Reptiles	Western Threadsnake	*Leptotyphlops humilis*	G5		Yes	UT	6	Yes
A	Reptiles	Flat-tailed Horned Lizard	*Phrynosoma mcallii*	G3	PT	Yes	AZ, CA	7	No
A	Reptiles	Common Chuckwalla	*Sauromalus ater*	G5		Yes	CA, NV, UT	61	No
A	Reptiles	Coachella Valley Fringe-toed Lizard	*Uma inornata*	G1	LT	Yes	CA	128	No
A	Reptiles	Mojave Fringe-toed Lizard	*Uma scoparia*	G3		Yes	AZ, CA	8	Yes
A	Reptiles	Desert Night Lizard	*Xantusia vigilis*	G5		Yes	AZ, UT	12	Yes
A	Terrestrial Snails	Morongo Desertsnail	*Eremarionta morongoana*	G2		No		1	No
A	Terrestrial Snails	Victorville Shoulderband	*Helminthoglypta mohaveana*	G1		No		2	Yes
A	Tiger Beetles	Mojave Giant Tiger Beetle	*Amblycheila schwarzi*	G3		No		2	No
A	Tiger Beetles	Riparian Tiger Beetle	*Cicindela praetextata*	G2		No		1	No
P	Conifers and relatives	Death Valley Mormon-tea	*Ephedra funerea*	G2		No		3	No
P	Conifers and relatives	Bristlecone Pine	*Pinus longaeva*	G4		Yes		1	No
P	Ferns and relatives	Upward-lobed Moonwort	*Botrychium ascendens*	G2		No		4	No
P	Ferns and relatives	Crenulate Moonwort	*Botrychium crenulatum*	G3		No		9	No
P	Ferns and relatives	Utah Spike-moss	*Selaginella utahensis*	G2		No		7	No
P	Flowering Plants		*Allium marvinii*	G1		No		1	No
P	Flowering Plants	Spanish Needle Onion	*Allium shevockii*	G1		No		9	No
P	Flowering Plants	Western Sand-parsley	*Ammoselinum giganteum*	G2		No		1	No
P	Flowering Plants	Rough Angelica	*Angelica scabrida*	G2		No		25	Yes

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P	Flowering Plants	Charleston Pussytoes	*Antennaria soliceps*	G1		No		36	Yes
P	Flowering Plants	Unequal Rockcress	*Arabis dispar*	G3		No		18	No
P	Flowering Plants	Parish's Rockcress	*Arabis parishii*	G2		No		69	No
P	Flowering Plants	Shockley's Rockcress	*Arabis shockleyi*	G3		No		84	Yes
P	Flowering Plants	Las Vegas Bear-poppy	*Arctomecon californica*	G3		Yes		383	Yes
P	Flowering Plants	Dwarf Bear-poppy	*Arctomecon humilis*	G1	LE	No		338	Yes
P	Flowering Plants	White Bear-poppy	*Arctomecon merriamii*	G3		No		171	Yes
P	Flowering Plants	Meadow Valley Sandwort	*Arenaria stenomeres*	G2		No		10	Yes
P	Flowering Plants	Bear Valley Sandwort	*Arenaria ursina*	G2	LT	No		50	No
P	Flowering Plants	California Silverbush	*Argythamnia californica*	G2		No		9	No
P	Flowering Plants	Ackerman's Milkvetch	*Astragalus ackermanii*	G2		No		9	Yes
P	Flowering Plants	Clokey's Milkvetch	*Astragalus aequalis*	G2		No		38	Yes
P	Flowering Plants	Cushenbury Milkvetch	*Astragalus albens*	G1	LE	No		29	Yes
P	Flowering Plants		*Astragalus ampullarioides*	G1	LE	No		6	Yes
P	Flowering Plants	Gumbo Milkvetch	*Astragalus ampullarius*	G2		No		1	No
P	Flowering Plants	Beatley's Milkvetch	*Astragalus beatleyae*	G2		No		23	No
P	Flowering Plants	Ertter's Milkvetch	*Astragalus ertterae*	G1		No		4	No
P	Flowering Plants	Black Milkvetch	*Astragalus funereus*	G2		No		21	Yes
P	Flowering Plants	Sand Milkvetch	*Astragalus geyeri var. triquetrus*	T2		Yes		50	Yes
P	Flowering Plants	Gilman's Milkvetch	*Astragalus gilmanii*	G2		No		12	No
P	Flowering Plants	Holmgren's Milkvetch	*Astragalus holmgreniorum*	G1	LE	Yes		29	Yes
P	Flowering Plants	Inyo Milkvetch	*Astragalus inyoensis*	G3		No		1	No
P	Flowering Plants	Lane Mountain Milkvetch	*Astragalus jaegerianus*	G1	LE	No		7	Yes
P	Flowering Plants	Coachella Valley Milkvetch	*Astragalus lentiginosus var. coachellae*	T2	LE	No		89	No
P	Flowering Plants	Sodaville Milkvetch	*Astragalus lentiginosus var. sesquimetralis*	T1		Yes		1	No
P	Flowering Plants	Big Bear Valley Woollypod	*Astragalus leucolobus*	G2		No		58	No
P	Flowering Plants	Mokiah Milkvetch	*Astragalus mokiacensis*	G2		No		7	Yes
P	Flowering Plants	Nye Milkvetch	*Astragalus nyensis*	G3		No		27	Yes
P	Flowering Plants	Ash Meadows Milkvetch	*Astragalus phoenix*	G2	LT	Yes		13	No
P	Flowering Plants	Raven's Milkvetch	*Astragalus ravenii*	G1		No		2	No
P	Flowering Plants	Spring Mountain Milkvetch	*Astragalus remotus*	G2		No		17	Yes
P	Flowering Plants	Silver Reef Milkvetch	*Astragalus straturensis*	G2		No		16	No
P	Flowering Plants	Triple-rib Milkvetch	*Astragalus tricarinatus*	G1	LE	No		12	Yes
P	Flowering Plants	Parish's Saltbush	*Atriplex parishii*	G1		No		1	Yes
P	Flowering Plants	Kofka Barberry	*Berberis harrisoniana*	G1		No		1	No
P	Flowering Plants	Last Chance Rock Cress	*Boechera yorkii*	G1		No		2	No
P	Flowering Plants	Inyo County Mariposa-lily	*Calochortus excavatus*	G3		No		31	No
P	Flowering Plants	Panamint Mountain Mariposa Lily	*Calochortus panamintensis*	G3		No		1	No
P	Flowering Plants	Plummer's Mariposa-lily	*Calochortus plummerae*	G3		No		2	No
P	Flowering Plants	Alkali Mariposa-lily	*Calochortus striatus*	G2		No		254	Yes

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P	Flowering Plants	Peirson's Morning-glory	*Calystegia peirsonii*	G3		No		13	No
P	Flowering Plants	Baird's Camissonia	*Camissonia bairdii*	G1		No		3	No
P	Flowering Plants	Diamond Valley Suncup	*Camissonia gouldii*	G1		No		2	Yes
P	Flowering Plants	Kern River Evening-primrose	*Camissonia integrifolia*	G3		No		3	No
P	Flowering Plants	White Canbya	*Canbya candida*	G3		No		29	Yes
P	Flowering Plants	Hays' Sedge	*Carex haysii*	G1		No		1	No
P	Flowering Plants	Crucifixion Thorn	*Castela emoryi*	G3		Yes		20	No
P	Flowering Plants	Ash Grey Indian-paintbrush	*Castilleja cinerea*	G2	LT	No		85	No
P	Flowering Plants	Mt. Gleason Indian Paintbrush	*Castilleja gleasoni*	G2		Yes		4	No
P	Flowering Plants	San Bernardino Owl's-clover	*Castilleja lasiorhyncha*	G2		No		46	No
P	Flowering Plants	Payson's Caulanthus	*Caulanthus simulans*	G3		No		1	No
P	Flowering Plants	Jaeger's Caulostramina	*Caulostramina jaegeri*	G1		No		6	No
P	Flowering Plants	Spring-loving Centaury	*Centaurium namophilum*	G2	LT	Yes		23	Yes
P	Flowering Plants	Flatseed Spurge	*Chamaesyce platysperma*	G3		No		2	No
P	Flowering Plants	San Fernando Valley Chorizanthe	*Chorizanthe parryi var. fernandina*	T1	C	Yes		5	No
P	Flowering Plants	Pintwater Rabbitbrush	*Chrysothamnus eremobius*	G1		No		4	Yes
P	Flowering Plants	Clokey's Thistle	*Cirsium clokeyi*	G2		No		27	Yes
P	Flowering Plants	Virgin Thistle	*Cirsium virginense*	G2		Yes		11	Yes
P	Flowering Plants	Pygmy Pussy-paws	*Cistanthe pygmaea*	G2		No		4	No
P	Flowering Plants	Tecopa Bird's-beak	*Cordylanthus tecopensis*	G2		No		12	No
P	Flowering Plants		*Coryphantha chlorantha*	G2		No		8	No
P	Flowering Plants	Clokey's Cat's-eye	*Cryptantha clokeyi*	G1		No		5	No
P	Flowering Plants	Unusual Cat's-eye	*Cryptantha insolita*	GH		Yes		4	No
P	Flowering Plants	Bristle-cone Cryptantha	*Cryptantha roosiorum*	G1		Yes		24	No
P	Flowering Plants	Pipe Springs Cryptantha	*Cryptantha semiglabra*	G1		No		1	No
P	Flowering Plants	Desert Cymopterus	*Cymopterus deserticola*	G3		No		217	Yes
P	Flowering Plants	July Gold	*Dedeckera eurekensis*	G2		Yes		21	Yes
P	Flowering Plants	Unexpected Larkspur	*Delphinium inopinum*	G3		No		8	No
P	Flowering Plants	Kern County Larkspur	*Delphinium purpusii*	G2		No		2	No
P	Flowering Plants	Byron Larkspur	*Delphinium recurvatum*	G2		No		1	No
P	Flowering Plants	Wasatch Draba	*Draba brachystylis*	G1		No		5	No
P	Flowering Plants	Jaeger Whitlowgrass	*Draba jaegeri*	G2		No		15	Yes
P	Flowering Plants	Charleston Draba	*Draba paucifructa*	G1		No		33	Yes
P	Flowering Plants	Mt. Whitney Draba	*Draba sharsmithii*	G1		No		4	No
P	Flowering Plants	Engelmann's Hedgehog Cactus	*Echinocereus engelmannii var. armatus*	T2		Yes		1	No
P	Flowering Plants	Silver-leaf Sunray	*Enceliopsis argophylla*	G2		No		6	Yes
P	Flowering Plants	Panamint Daisy	*Enceliopsis covillei*	G3		No		9	Yes
P	Flowering Plants	Ash Meadows Sunray	*Enceliopsis nudicaulis var. corrugata*	T2	LT	Yes		17	Yes
P	Flowering Plants	Nevada Willowherb	*Epilobium nevadense*	G2		No		14	Yes
P	Flowering Plants	Hoover's Eriastrum	*Eriastrum hooveri*	G3		No			Yes

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P	Flowering Plants	Charleston Mountain Heath-goldenrod	*Ericameria compacta*	G2		No		12	No
P	Flowering Plants	Pine Valley Goldenbush	*Ericameria crispa*	G2		No		2	No
P	Flowering Plants	Gilman Goldenweed	*Ericameria gilmanii*	G1		No		5	No
P	Flowering Plants	Hall's Daisy	*Erigeron aequifolius*	G2		No		1	No
P	Flowering Plants	Bald Daisy	*Erigeron calvus*	G1		No		1	No
P	Flowering Plants	Mound Daisy	*Erigeron compactus*	G2		No		1	No
P	Flowering Plants	Sheep Fleabane	*Erigeron ovinus*	G2		No		14	Yes
P	Flowering Plants	Parish's Daisy	*Erigeron parishii*	G2	LT	No		52	Yes
P	Flowering Plants	Zion Daisy	*Erigeron sionis*	G2		No		10	No
P	Flowering Plants	Forked Buckwheat	*Eriogonum bifurcatum*	G2		No		317	No
P	Flowering Plants	Tehachapi Buckwheat	*Eriogonum callistum*	G1		No		1	No
P	Flowering Plants	Darin Buckwheat	*Eriogonum concinnum*	G2		No		14	No
P	Flowering Plants	Reveal's Buckwheat	*Eriogonum contiguum*	G2		No		16	Yes
P	Flowering Plants	Crispleaf Wild Buckwheat	*Eriogonum corymbosum var. nilesii*	T2	C	No		177	No
P	Flowering Plants	Wildrose Canyon Buckwheat	*Eriogonum eremicola*	G1		No		5	No
P	Flowering Plants	Thorne's Buckwheat	*Eriogonum ericifolium var. thornei*	T1		Yes		2	Yes
P	Flowering Plants	Gilman's Buckwheat	*Eriogonum gilmanii*	G2		No		10	No
P	Flowering Plants	Jointed Buckwheat	*Eriogonum intrafractum*	G2		No		14	No
P	Flowering Plants	Southern Mountain Buckwheat	*Eriogonum kennedyi var. austromontanum*	T2	LT	No		102	No
P	Flowering Plants	Cushenbury Buckwheat	*Eriogonum ovalifolium var. vineum*	T1	LE	No		95	No
P	Flowering Plants	Sticky Buckwheat	*Eriogonum viscidulum*	G2		Yes		39	Yes
P	Flowering Plants	Barstow Wooly-sunflower	*Eriophyllum mohavense*	G2		No		78	Yes
P	Flowering Plants	Largeleaf Filaree	*Erodium macrophyllum*	G3		No		4	No
P	Flowering Plants	Cushion Fox-tail Cactus	*Escobaria alversonii*	G3		No		69	No
P	Flowering Plants	Viviparous Foxtail Cactus	*Escobaria vivipara var. rosea*	T3		Yes		46	No
P	Flowering Plants	San Gabriel Bedstraw	*Galium grande*	G2		No		1	No
P	Flowering Plants	Little San Bernardino Mountains gilia	*Gilia maculata*	G1		No		35	Yes
P	Flowering Plants	Nye Gilia	*Gilia nyensis*	G3		No		26	No
P	Flowering Plants	Ripley's Gilia	*Gilia ripleyi*	G3		No		57	Yes
P	Flowering Plants	Golden Carpet	*Gilmania luteola*	G1		No		13	Yes
P	Flowering Plants	Clokey's Greasebush	*Glossopetalon clokeyi*	G2		No		16	Yes
P	Flowering Plants	Pacific Greasebush	*Glossopetalon pungens*	G2		No		1	Yes
P	Flowering Plants	Ash Meadows Gumweed	*Grindelia fraxinopratensis*	G2	LT	Yes		22	No
P	Flowering Plants	Sharsmith's Stickseed	*Hackelia sharsmithii*	G3		No		13	No
P	Flowering Plants	Utah Sunflower	*Helianthus deserticola*	G2		No		5	No
P	Flowering Plants	Red Rock tarplant	*Hemizonia arida*	G1		Yes		29	No
P	Flowering Plants	Mohave Tarplant	*Hemizonia mohavensis*	G2		Yes		15	Yes
P	Flowering Plants	Jones Golden-aster	*Heterotheca jonesii*	G2		No		7	No
P	Flowering Plants	Shaggy-hair Alumroot	*Heuchera hirsutissima*	G2		No		6	No
P	Flowering Plants	Parish's Alumroot	*Heuchera parishii*	G2		No		4	No

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P	Flowering Plants	Rock Lady	*Holmgrenanthe petrophila*	G1		Yes		18	Yes
P	Flowering Plants	Sanderson's Cheesebush	*Hymenoclea sandersonii*	G1		No		1	No
P	Flowering Plants	California Satintail	*Imperata brevifolia*	G2		No		7	No
P	Flowering Plants	Spring Mountain Ankle-aster	*Ionactis caelestis*	G1		No		3	Yes
P	Flowering Plants	Silver-haired Ivesia	*Ivesia argyrocoma*	G2		No		49	No
P	Flowering Plants	Field Ivesia	*Ivesia campestris*	G3		No		1	No
P	Flowering Plants	Hidden Ivesia	*Ivesia cryptocaulis*	G2		No		13	Yes
P	Flowering Plants	Jaeger's Ivesia	*Ivesia jaegeri*	G2		No		46	Yes
P	Flowering Plants	Ash Meadows Mousetail	*Ivesia kingii var. eremica*	T1	LT	Yes		9	No
P	Flowering Plants	Kingston Mountains Ivesia	*Ivesia patellifera*	G1		No		6	Yes
P	Flowering Plants	Bullfrog Hills Sweetpea	*Lathyrus hitchcockianus*	G2		No		14	Yes
P	Flowering Plants	Pale-yellow Layia	*Layia heterotricha*	G2		No		4	No
P	Flowering Plants	San Joaquin Woolly Threads	*Lembertia congdonii*	G3	LE	No		2	No
P	Flowering Plants	Ross' Pitcher Sage	*Lepechinia rossii*	G1		No		2	No
P	Flowering Plants	San Jacinto Prickly Phlox	*Leptodactylon jaegeri*	G2		No		6	No
P	Flowering Plants	Hitchcock's Bladderpod	*Lesquerella hitchcockii*	G3		No			Yes
P	Flowering Plants	San Bernardino Mountains Bladderpod	*Lesquerella kingii ssp. bernardina*	T1	LE	No		6	No
P	Flowering Plants	Yosemite Lewisia	*Lewisia disepala*	G2		No		4	No
P	Flowering Plants	Lemon Lily	*Lilium parryi*	G3		Yes		33	No
P	Flowering Plants	San Gabriel Linanthus	*Linanthus concinnus*	G2		No		8	No
P	Flowering Plants	Baldwin Lake Linanthus	*Linanthus killipii*	G2		No		26	No
P	Flowering Plants	Owen's Peak lomatium	*Lomatium shevockii*	G1		No		4	No
P	Flowering Plants	Holmgren Lupine	*Lupinus holmgrenianus*	G2		No		6	Yes
P	Flowering Plants	Father Crowley's Lupine	*Lupinus padre-crowleyi*	G2		Yes		3	No
P	Flowering Plants	Peirson's Lupine	*Lupinus peirsonii*	G2		No		6	No
P	Flowering Plants	Davidson's Bushmallow	*Malacothamnus davidsonii*	G1		No		2	No
P	Flowering Plants	Inyo balzingstar	*Mentzelia inyoensis*	G2		No		5	No
P	Flowering Plants	Ash Meadows Blazingstar	*Mentzelia leucophylla*	G1	LT	Yes		8	No
P	Flowering Plants	Polished Blazingstar	*Mentzelia polita*	G2		No		2	No
P	Flowering Plants	Three-tooth Blazingstar	*Mentzelia tridentata*	G2		No		9	No
P	Flowering Plants	San Bernardino Mountain Monkeyflower	*Mimulus exiguus*	G2		No		24	No
P	Flowering Plants	Mojave Monkeyflower	*Mimulus mohavensis*	G2		No		53	Yes
P	Flowering Plants	Calico Monkeyflower	*Mimulus pictus*	G2		No		3	No
P	Flowering Plants	Little Purple Monkeyflower	*Mimulus purpureus*	G2		No		29	No
P	Flowering Plants	Kelso Creek Monkeyflower	*Mimulus shevockii*	G2		No		18	No
P	Flowering Plants	Bashful Four-o'clock	*Mirabilis pudica*	G3		No		2	Yes
P	Flowering Plants	sweet-smelling monardella	*Monardella beneolens*	G1		No		6	No
P	Flowering Plants	Robison's Monardella	*Monardella robisonii*	G2		No		56	No

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P	Flowering Plants	California Muhly	*Muhlenbergia californica*	G3		No		2	No
P	Flowering Plants	Piute Mountains Navarretia	*Navarretia setiloba*	G1		No		1	No
P	Flowering Plants	Amargosa Niterwort	*Nitrophila mohavensis*	G1	LE	Yes		6	No
P	Flowering Plants	Eureka Dunes Evening-primrose	*Oenothera californica ssp. eurekensis*	T1	LE	Yes		3	Yes
P	Flowering Plants	Cave Evening-primrose	*Oenothera cavernae*	G2		No		4	No
P	Flowering Plants	Golden Prickly-pear	*Opuntia aurea*	G3		Yes		3	No
P	Flowering Plants	Bakersfield Beavertail Cactus	*Opuntia basilaris var. treleasei*	T2	LE	Yes		27	No
P	Flowering Plants	Sand Cholla	*Opuntia pulchella*	G4		Yes		1	No
P	Flowering Plants	Blue Diamond Cholla	*Opuntia whipplei var. multigeniculata*	T2		Yes		10	Yes
P	Flowering Plants	Woolly Mountain-parsley	*Oreonana vestita*	G3		No		12	No
P	Flowering Plants	Nevada Oryctes	*Oryctes nevadensis*	G2		No		18	No
P	Flowering Plants	Cushenbury Oxytheca	*Oxytheca parishii var. goodmaniana*	T1	LE	No		24	No
P	Flowering Plants	San Bernardino Butterweed	*Packera bernardina*	G2		No		30	No
P	Flowering Plants	Fringed Grass-of-Parnassus	*Parnassia cirrata*	G2		No		1	No
P	Flowering Plants	Siler Pincushion Cactus	*Pediocactus sileri*	G3	LT	Yes		5	Yes
P	Flowering Plants	Beaver Scurf-pea	*Pediomelum castoreum*	G3		No		16	Yes
P	Flowering Plants	White-margin Beardtongue	*Penstemon albomarginatus*	G2		Yes		28	Yes
P	Flowering Plants	Dune Beardtongue	*Penstemon arenarius*	G2		No		1	No
P	Flowering Plants	Rosy Bicolored Beardtongue	*Penstemon bicolor ssp. roseus*	T3		Yes		55	Yes
P	Flowering Plants	Limestone Beardtongue	*Penstemon calcareus*	G2		No		21	Yes
P	Flowering Plants	Pahute Mesa Beardtongue	*Penstemon pahutensis*	G3		No		28	Yes
P	Flowering Plants	Petiolate Beardtongue	*Penstemon petiolatus*	G2		No		13	No
P	Flowering Plants	Stephen's Beardtongue	*Penstemon stephensii*	G2		No		14	Yes
P	Flowering Plants	Inyo Rock Daisy	*Perityle inyoensis*	G2		No		7	No
P	Flowering Plants	Hanaupah rock daisy	*Perityle villosa*	G1		No		7	Yes
P	Flowering Plants	Parry Sandpaper-plant	*Petalonyx parryi*	G2		No			Yes
P	Flowering Plants	marble rockmat	*Petrophyton acuminatum*	G1		No		1	No
P	Flowering Plants	Aven Nelson's Phacelia	*Phacelia anelsonii*	G2		No		15	Yes
P	Flowering Plants	Beatley's Phacelia	*Phacelia beatleyae*	G3		No		25	No
P	Flowering Plants		*Phacelia filiae*	G2		No		24	No
P	Flowering Plants	Geranium-leaf Scorpionweed	*Phacelia geraniifolia*	G2		No		1	No
P	Flowering Plants	Inyo Phacelia	*Phacelia inyoensis*	G3		No		5	No
P	Flowering Plants	Nodding-flower Scorpionweed	*Phacelia laxiflora*	G2		No		4	No
P	Flowering Plants	Mono County Phacelia	*Phacelia monoensis*	G3		No		1	No
P	Flowering Plants	Death Valley Roundleaf Phacelia	*Phacelia mustelina*	G2		No		25	Yes
P	Flowering Plants	Nash's Phacelia	*Phacelia nashiana*	G3		No		109	Yes
P	Flowering Plants	Nine Mile Canyon Phacelia	*Phacelia novenmillensis*	G2		No		14	No
P	Flowering Plants	Parish's Phacelia	*Phacelia parishii*	G2		No		12	Yes
P	Flowering Plants	Bear Valley Phlox	*Phlox dolichantha*	G2		No		37	No
P	Flowering Plants	Parish's Popcorn-flower	*Plagiobothrys parishii*	G1		No		6	No

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P	Flowering Plants	Desert Allocarya	*Plagiobothrys salsus*	G2		No		2	No
P	Flowering Plants	San Bernardino Bluegrass	*Poa atropurpurea*	G2	LE	No		21	No
P	Flowering Plants	Spiny Milkwort	*Polygala heterorhyncha*	G3		No		7	No
P	Flowering Plants	Pygmy Poreleaf	*Porophyllum pygmaeum*	G2		No		13	Yes
P	Flowering Plants		*Prunus eremophila*	G1		No		49	No
P	Flowering Plants	Parish's Alkali Grass	*Puccinellia parishii*	G2		Yes		1	Yes
P	Flowering Plants	Muir's Raillardiopsis	*Raillardiopsis muirii*	G2		No		1	No
P	Flowering Plants		*Saltugilia latimeri*	G2		No		15	No
P	Flowering Plants	Death Valley Sage	*Salvia funerea*	G3		No		4	No
P	Flowering Plants	Orocopia Sage	*Salvia greatae*	G2		No		2	Yes
P	Flowering Plants	Mohave Fishhook Cactus	*Sclerocactus polyancistrus*	G4		Yes		14	No
P	Flowering Plants	Davidson's Stonecrop	*Sedum niveum*	G3		No			Yes
P	Flowering Plants	Owens Valley Checker-mallow	*Sidalcea covillei*	G3		Yes		23	No
P	Flowering Plants	Pedate Checker-mallow	*Sidalcea pedata*	G1	LE	Yes		41	No
P	Flowering Plants	Clokey's Catchfly	*Silene clokeyi*	G2		No		7	Yes
P	Flowering Plants	Funeral Mountain Blue-eyed-grass	*Sisyrinchium funereum*	G2		No		14	No
P	Flowering Plants	Big-root Blue-eyed-grass	*Sisyrinchium radicatum*	G2		No		5	No
P	Flowering Plants		*Sphaeralcea gierischii*	G1	C	No		3	No
P	Flowering Plants	Charleston Tansy	*Sphaeromeria compacta*	G2		No		34	Yes
P	Flowering Plants	Zion Tansy	*Sphaeromeria ruthiae*	G2		No		1	No
P	Flowering Plants	Ash Meadows Ladies'-tresses	*Spiranthes infernalis*	G1		No		15	No
P	Flowering Plants	California Jewelflower	*Stanfordia californica*	G1	LE	Yes		1	No
P	Flowering Plants	Laguna Mountains Streptanthus	*Streptanthus bernardinus*	G3		No		11	No
P	Flowering Plants	Southern Jewelflower	*Streptanthus campestris*	G2		No		3	No
P	Flowering Plants	Alpine Jewelflower	*Streptanthus gracilis*	G3		No		3	No
P	Flowering Plants	Eureka Dunes Grass	*Swallenia alexandrae*	G1	LE	Yes		5	Yes
P	Flowering Plants	San Bernardino Aster	*Symphyotrichum defoliatum*	G3		No		6	No
P	Flowering Plants	Greata's Aster	*Symphyotrichum greatae*	G2		No		6	No
P	Flowering Plants	Welsh's American-aster	*Symphyotrichum welshii*	G2		No		3	No
P	Flowering Plants	Charleston Kittentails	*Synthyris ranunculina*	G2		No		43	Yes
P	Flowering Plants	California Dandelion	*Taraxacum californicum*	G2	LE	No		43	No
P	Flowering Plants	Holly-leaf Tetracoccus	*Tetracoccus ilicifolius*	G1		No		7	Yes
P	Flowering Plants	Slender-petal Thelypody	*Thelypodium stenopetalum*	G1	LE	Yes		14	No
P	Flowering Plants	Black Rock Ground-daisy	*Townsendia smithii*	G1		No			Yes
P	Flowering Plants	Dedecker's Clover	*Trifolium dedeckerae*	G2		No		10	No
P	Flowering Plants	Clausen's Violet	*Viola clauseniana*	G1		No		2	No
P	Flowering Plants	Mecca Aster	*Xylorhiza cognata*	G2		No		9	No
P	Mosses		*Didymodon nevadensis*	G2		No		12	Yes
P	Mosses		*Entosthodon planoconvexus*	G1		No		1	No
P	Mosses		*Grimmia americana*	G1		No		1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Mosses		*Orthotrichum shevockii*	G1		No		3	No
P	Mosses		*Orthotrichum spjutii*	G1		No		2	No
P	Mosses		*Pohlia tundrae*	G2		No		1	No
P	Mosses		*Trichostomum sweetii*	G2		No		2	No

Appendix 4b. Master Candidate Conservation Element List for Species in the Mojave Basin and Range Ecoregion using criteria c-d.

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Amphibians	Tiger Salamander	*Ambystoma tigrinum*	G5		No	DE, FL, KS, LA, MD, MI, MS, NC, NJ, NM, NY, SC, VA, WA, WY		Yes
A	Amphibians	Colorado River Toad	*Bufo alvarius*	G5		No	CA, NM	1	No
A	Amphibians	Red-spotted Toad	*Bufo punctatus*	G5		No	KS		Yes
A	Amphibians	Yellow-blotched Salamander	*Ensatina eschscholtzii croceator*	T2		No	CA	5	No
A	Amphibians	Canyon Treefrog	*Hyla arenicolor*	G5		No	AZ, CO, UT	7	Yes
A	Amphibians	Pacific Chorus Frog	*Pseudacris regilla*	G5		No	AZ, UT	52	Yes
A	Amphibians	Great Basin Spadefoot	*Spea intermontana*	G5		No	AZ, WY		Yes
A	Birds	A Yellow Warbler	*Dendroica petechia brewsteri*	T3		No	CA	11	Yes
A	Birds	Sonoran Yellow Warbler	*Dendroica petechia sonorana*	T2		No	CA	1	No
A	Birds	California Horned Lark	*Eremophila alpestris actia*	T3		No	CA	3	No
A	Birds	Gray-headed Junco	*Junco hyemalis caniceps*	T5		No	CA	8	No
A	Butterflies and Skippers	Spring Mountains acastus checkerspot	*Chlosyne acastus ssp.*	GNR		No			Yes
A	Butterflies and Skippers	Spring Mountains dark blue	*Euphilotes ancilla ssp. 1*	GNR		No			Yes
A	Butterflies and Skippers	Square-dotted Blue	*Euphilotes battoides*	G5		No			Yes
A	Butterflies and Skippers	Morand's Checkerspot	*Euphydryas anicia morandi*	T2		No		15	Yes
A	Butterflies and Skippers	Spring Mountains comma skipper	*Hesperia comma ssp. 1*	GNR		No			Yes
A	Butterflies and Skippers	Nevada Admiral	*Limenitis weidemeyerii nevadae*	T2		No		49	Yes
A	Butterflies and Skippers	Spring Mountains Icarioides Blue	*Plebejus icarioides austinorum*	T2		No		24	Yes
A	Butterflies and Skippers	Mt. Charleston Blue	*Plebejus shasta charlestonensis*	T1		No		12	Yes
A	Dragonflies and Damselflies	Bleached Skimmer	*Libellula composita*	G3		No		1	No
A	Fairy, Clam, and Tadpole Shrimps		*Fairy shrimp*	GNR		No			Yes
A	Freshwater and Anadromous Fishe	Amargosa Pupfish	*Cyprinodon nevadensis amargosae*	T1		No		3	Yes
A	Freshwater and Anadromous Fishe	Saratoga Springs Pupfish	*Cyprinodon nevadensis nevadensis*	T1		No		2	Yes
A	Freshwater and Anadromous Fishe	Salt Creek Pupfish	*Cyprinodon salinus salinus*	T1		No		1	Yes
A	Freshwater and Anadromous Fishe	Amargosa Canyon Speckled Dace	*Rhinichthys osculus ssp. 1*	T1		No		3	Yes
A	Freshwater and Anadromous Fishe	Meadow Valley Speckled Dace	*Rhinichthys osculus ssp. 11*	T2		No		7	Yes
A	Freshwater and Anadromous Fishe	White River Speckled Dace	*Rhinichthys osculus ssp. 7*	T2		No			Yes
A	Freshwater Snails	Blue Point Pyrg	*Pyrgulopsis coloradensis*	GH		No		1	Yes
A	Mammals	Ringtail	*Bassariscus astutus*	G5		No	LA, NV, OK, OR	3	No
A	Mammals	Dulzura California Pocket Mouse	*Chaetodipus californicus femoralis*	T3		No	CA	1	No
A	Mammals	Northwestern San Diego Pocket Mouse	*Chaetodipus fallax fallax*	T3		No	CA	10	No
A	Mammals	Pallid San Diego Pocket Mouse	*Chaetodipus fallax pallidus*	T3		No	CA	45	No
A	Mammals	Desert Pocket Mouse	*Chaetodipus penicillatus*	G5		No	NV	3	Yes
A	Mammals	Desert Kangaroo Rat	*Dipodomys deserti*	G5		No	NV, UT	8	Yes
A	Mammals	Earthquake Merriam's Kangaroo Rat	*Dipodomys merriami collinus*	T1		No	CA	2	No
A	Mammals	Merriam's kangaroo rat	*Dipodomys merriami frenatus*	GNR		No			Yes
A	Mammals	Panamint Kangaroo Rat	*Dipodomys panamintinus*	G5		No	NV	1	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Mammals	Argus Mountains Kangaroo Rat	*Dipodomys panamintinus argusensis*	T2		No	CA	4	No
A	Mammals	Panamint Kangaroo Rat	*Dipodomys panamintinus panamintinus*	T3		No	CA	4	No
A	Mammals	San Bernardino Flying Squirrel	*Glaucomys sabrinus californicus*	T2		No	CA	4	No
A	Mammals	Silver-haired Bat	*Lasionycteris noctivagans*	G5		No	AK, CA, CT, DE, IN, LA, MA, MD, MI, MS, NC, NH, NJ, NY, OR, PA, RI, VT, WI, WV, WY	9	Yes
A	Mammals	San Diego Black-tailed Jackrabbit	*Lepus californicus bennettii*	T3		No	CA	1	No
A	Mammals	Sierra Marten	*Martes americana sierrae*	T3		No	CA	1	No
A	Mammals	Mohave Vole	*Microtus californicus mohavensis*	T1		No	CA	5	Yes
A	Mammals	Stephens' California Vole	*Microtus californicus stephensi*	T1		No	CA	1	No
A	Mammals	Owens Valley Vole	*Microtus californicus vallicola*	T1		No	CA	9	No
A	Mammals	Californian Myotis	*Myotis californicus*	G5		No	AK, AZ, OR, WA	10	Yes
A	Mammals	Western Small-footed Myotis	*Myotis ciliolabrum*	G5		No	CA, KS, ND, NV, WA, WY	24	Yes
A	Mammals	Long-eared Myotis	*Myotis evotis*	G5		No	CA, ND, WA, WY	17	Yes
A	Mammals	Little Brown Myotis	*Myotis lucifugus*	G5		No	AK, AL, CA, CT, IN, KS, MS, NV, RI, VT, WY	3	No
A	Mammals	Arizona Myotis	*Myotis occultus*	G3		No	CA, CO, NM		Yes
A	Mammals	Cave Myotis	*Myotis velifer*	G5		No	CA, NV, TX	1	No
A	Mammals	Long-legged Myotis	*Myotis volans*	G5		No	AK, CA, ND, NE, OR, WA, WY	31	Yes
A	Mammals	Yuma Myotis	*Myotis yumanensis*	G5		No	CA, TX, UT, WA	22	Yes
A	Mammals	Panamint Chipmunk	*Neotamias panamintinus*	G4		No			Yes
A	Mammals	Kingston Mountain Chipmunk	*Neotamias panamintinus acrus*	T1		No	CA	5	No
A	Mammals	Lodgepole Chipmunk	*Neotamias speciosus speciosus*	T2		No	CA	13	No
A	Mammals	Colorado Valley Woodrat	*Neotoma albigula venusta*	T3		No	CA	1	No
A	Mammals	San Diego Desert Woodrat	*Neotoma lepida intermedia*	T3		No	CA	1	No
A	Mammals	Crawford's Gray Shrew	*Notiosorex crawfordi*	G5		No	AR, OK, TX, UT	3	No
A	Mammals	Pocketed Free-tailed Bat	*Nyctinomops femorosaccus*	G4		No	CA, NM, TX	2	No
A	Mammals	Southern Grasshopper Mouse	*Onychomys torridus ramona*	T3		No	CA	1	No
A	Mammals	Tulare Grasshopper Mouse	*Onychomys torridus tularensis*	T1		No	CA	6	No
A	Mammals	Western Pipistrelle	*Parastrellus hesperus*	G5		No	AZ, WA	27	No
A	Mammals	White-eared Pocket Mouse	*Perognathus alticolus alticolus*	TH		No	CA	2	No
A	Mammals	Tehachapi Pocket Mouse	*Perognathus alticolus inexpectatus*	T1		No	CA	8	No
A	Mammals	San Joaquin Pocket Mouse	*Perognathus inornatus inornatus*	T2		No	CA	3	No
A	Mammals	Palm Springs Little Pocket Mouse	*Perognathus longimembris bangsi*	T2		No	CA	9	No
A	Mammals	Los Angeles Pocket Mouse	*Perognathus longimembris brevinasus*	T1		No	CA	5	No
A	Mammals	Yellow-eared Pocket Mouse	*Perognathus parvus xanthonotus*	T2		No	CA	6	No
A	Mammals	Cactus Deermouse	*Peromyscus eremicus*	G5		No		16	Yes
A	Mammals	Merriam's Shrew	*Sorex merriami leucogenys*	T5		No	NV	1	No
A	Mammals	Inyo Shrew	*Sorex tenellus*	G3		No	NV	5	No
A	Mammals	American Badger	*Taxidea taxus*	G5		No	AR, CA, IL, IN, MN, OH, TX, WA	34	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Other Beetles	A Crawling Water Beetle	*Haliplus eremicus*	GNR		No		1	Yes
A	Other Beetles	A Nearctic Riffle Beetle	*Stenelmis occidentalis*	G4		No		3	Yes
A	Reptiles	Southern Pacific Pond Turtle	*Actinemys marmorata pallida*	T2		No	CA		Yes
A	Reptiles	Silvery Legless Lizard	*Anniella pulchra pulchra*	T3		No	CA	9	No
A	Reptiles	Glossy Snake	*Arizona elegans*	G5		No	KS, NE, UT	17	Yes
A	Reptiles	Isla Cedros Whiptail	*Aspidoscelis tigris multiscutata*	TNR		No			Yes
A	Reptiles	Coastal Whiptail	*Aspidoscelis tigris stejnegeri*	T5		No	CA	1	No
A	Reptiles	Plateau Striped Whiptail	*Aspidoscelis velox*	G5		No	UT	6	Yes
A	Reptiles	Desert Rosy Boa	*Charina trivirgata gracia*	T3		No	AZ		Yes
A	Reptiles	Utah Banded Gecko	*Coleonyx variegatus utahensis*	T4		No	AZ		Yes
A	Reptiles	Red Diamond Rattlesnake	*Crotalus ruber ruber*	T5		No	CA	13	No
A	Reptiles	Mojave collared lizard	*Crotaphitus insularais bicinctores*	GNR		No			Yes
A	Reptiles	Ring-necked Snake	*Diadophis punctatus*	G5		No	DC, ID, MI, UT, WA	5	No
A	Reptiles	Western Redtail Skink	*Eumeces gilberti rubricaudatus*	T4		No			Yes
A	Reptiles	Long-nosed Leopard Lizard	*Gambelia wislizenii*	G5		No	CO, NV, TX, UT		Yes
A	Reptiles	Common Kingsnake	*Lampropeltis getula*	G5		No	CO, DE, FL, IA, NE, OR, UT	16	No
A	Reptiles	California Kingsnake	*Lampropeltis getula californiae*	T5		No	NM		Yes
A	Reptiles	Utah Mountain Kingsnake	*Lampropeltis pyromelana infralabialis*	T3		No	AZ		Yes
A	Reptiles	Rosy Boa	*Lichanura trivirgata*	G4		No	CA	6	Yes
A	Reptiles	Coachwhip	*Masticophis flagellum*	G5		No	IL, MS, NC, NE, TN, UT	24	No
A	Reptiles	Blainville's Horned Lizard	*Phrynosoma blainvillii*	G3		No		49	No
A	Reptiles	San Diego horned lizard	*Phrynosoma coronatum blainvillei*	GNR		No			Yes
A	Reptiles	Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*	T5		No			Yes
A	Reptiles	Spotted Leaf-nosed Snake	*Phyllorhynchus decurtatus*	G5		No	UT	1	Yes
A	Reptiles	Long-nosed Snake	*Rhinocheilus lecontei*	G5		No	CO, ID, KS, OK, UT	2	No
A	Reptiles	Western longnosed snake	*Rhinocheilus lecontei lecontei*	GNR		No			Yes
A	Reptiles	Western Patch-nosed Snake	*Salvadora hexalepis*	G5		No	UT	10	No
A	Reptiles	Mojave Patch-nosed Snake	*Salvadora hexalepis mojavensis*	T5		No			Yes
A	Reptiles	Western chuckwalla	*Sauromalus obesus obesus*	GNR		No			Yes
A	Reptiles	Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*	T5		No	CA, OR	1	No
A	Reptiles	Groundsnake	*Sonora semiannulata*	G5		No	AR, ID, KS, UT	12	No
A	Reptiles	Smith's Black-headed Snake	*Tantilla hobartsmithi*	G5		No	AZ, CO, UT	9	No
A	Reptiles	Two-striped Gartersnake	*Thamnophis hammondii*	G4		No	CA	7	Yes
A	Reptiles	Sonoran Lyresnake	*Trimorphodon lambda*	G5		No	NV	5	Yes
A	Terrestrial Snails	Baker's Desertsnail	*Eremarionta rowelli bakerensis*	T1		No		1	Yes
A	Tiger Beetles	Maricopa Tiger Beetle	*Cicindela oregona maricopa*	T3		No		4	Yes
A	Turtles	Western Pond Turtle	*Actinemys marmorata*	G3		No	CA, WA	15	No
P	Ferns and relatives	Southwestern False Cloak Fern	*Argyrochosma limitanea ssp. limitanea*	T3		No		1	Yes
P	Flowering Plants	California Buckeye	*Aesculus californica*	G5		No			Yes
P	Flowering Plants	Ivory Spined Agave	*Agave utahensis var. eborispina*	T3		No		20	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Clark Mountain Agave	*Agave utahensis var. nevadensis*	T3		No		3	Yes
P	Flowering Plants	Smallflower Androstephium	*Androstephium breviflorum*	G5		No		21	Yes
P	Flowering Plants	Chihuahuan Ringstem	*Anulocaulis leiosolenus*	G4		No		4	Yes
P	Flowering Plants	Rosy King's Sandwort	*Arenaria kingii ssp. rosea*	T2		No		25	Yes
P	Flowering Plants	Halfmoon Milkvetch	*Astragalus allochrous var. playanus*	T3		No		2	Yes
P	Flowering Plants	Sheep Mountain Milkvetch	*Astragalus amphioxys var. musimonum*	T2		No		16	Yes
P	Flowering Plants	One-leaflet Torrey Milkvetch	*Astragalus calycosus var. monophyllidius*	T2		No		1	Yes
P	Flowering Plants	Cima Milkvetch	*Astragalus cimae var. cimae*	T2		No		16	Yes
P	Flowering Plants	Shining Milkvetch	*Astragalus lentiginosus var. micans*	T1		No		2	Yes
P	Flowering Plants	Half-ring Pod Milkvetch	*Astragalus mohavensis var. hemigyrus*	T2		No		43	Yes
P	Flowering Plants	Charleston Milkvetch	*Astragalus oophorus var. clokeyanus*	T2		No		25	Yes
P	Flowering Plants	Preuss' Milkvetch	*Astragalus preussii var. preussii*	T4		No		2	Yes
P	Flowering Plants	Intermountain Evening-primrose	*Camissonia megalantha*	G3		No		28	Yes
P	Flowering Plants	Clokey's Paintbrush	*Castilleja applegatei ssp. 1*	T3		No		46	Yes
P	Flowering Plants	Bush-loving Cat's-eye	*Cryptantha dumetorum*	G3		No		3	No
P	Flowering Plants	New York Mountains Cryptantha	*Cryptantha tumulosa*	G4		No		10	Yes
P	Flowering Plants	Gilman Cymopterus	*Cymopterus gilmanii*	G3		No		38	Yes
P	Flowering Plants	Abrams' Live-forever	*Dudleya abramsii ssp. affinis*	T2		No		12	Yes
P	Flowering Plants	Chalk Live-forever	*Dudleya pulverulenta*	G4		No			Yes
P	Flowering Plants	Howe's Hedgehog Cactus	*Echinocereus engelmannii var. howei*	T1		No		3	Yes
P	Flowering Plants	Nine-awned Pappus Grass	*Enneapogon desvauxii*	G5		No		7	Yes
P	Flowering Plants	Deer Goldenweed	*Ericameria cervina*	G3		No		3	No
P	Flowering Plants	Wand-like Fleabane	*Erigeron oxyphyllus*	G3		No		2	No
P	Flowering Plants	Inch High Fleabane	*Erigeron uncialis ssp. conjugans*	T3		No		6	Yes
P	Flowering Plants	Limestone Daisy	*Erigeron uncialis ssp. uncialis*	T2		No		7	Yes
P	Flowering Plants	Narrowleaf Yerba Santa	*Eriodictyon angustifolium*	G5		No		7	Yes
P	Flowering Plants	Heermann's Buckwheat	*Eriogonum heermannii var. clokeyi*	T2		No		10	Yes
P	Flowering Plants	Clark Mountain Wild Buckwheat	*Eriogonum heermannii var. floccosum*	T3		No			Yes
P	Flowering Plants	Cache Peak Buckwheat	*Eriogonum kennedyi var. pinicola*	T1		No		5	Yes
P	Flowering Plants	Downy Buckwheat	*Eriogonum puberulum*	G3		No		2	No
P	Flowering Plants	Twisselmann's Poppy	*Eschscholzia minutiflora ssp. twisselmannii*	T2		No		71	Yes
P	Flowering Plants	Hot Springs Fimbry	*Fimbristylis thermalis*	G4		No		6	Yes
P	Flowering Plants	Kingston Bedstraw	*Galium hilendiae ssp. kingstonense*	T2		No		8	Yes
P	Flowering Plants	Wright's Bedstraw	*Galium wrightii*	G3		No		3	No
P	Flowering Plants	Brickell's Hazardia	*Hazardia brickellioides*	G3		No		14	No
P	Flowering Plants	Grand Canyon Evening Daisy	*Hesperodoria scopulorum*	G4		No			Yes
P	Flowering Plants	Arizona Bladderpod	*Lesquerella arizonica*	G3		No		5	No
P	Flowering Plants	Sand Linanthus	*Linanthus arenicola*	G3		No			Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Sage-like Loeflingia	*Loeflingia squarrosa ssp. artemisiarum*	T2		No		14	Yes
P	Flowering Plants	King Desert-parsley	*Lomatium graveolens var. alpinum*	T3		No		1	Yes
P	Flowering Plants	Wright's Hosackia	*Lotus argyraeus var. multicaulis*	T1		No		6	Yes
P	Flowering Plants	Panamint Mountains Lupine	*Lupinus magnificus var. magnificus*	T1		No		11	Yes
P	Flowering Plants	Common Wolf's-tail	*Lycurus phleoides var. phleoides*	T4		No			Yes
P	Flowering Plants	Spearleaf Milkvine	*Matelea parvifolia*	G5		No		7	Yes
P	Flowering Plants	Parry's Monkeyflower	*Mimulus parryi*	G3		No		2	No
P	Flowering Plants	Utah Mortinia	*Mortonia utahensis*	G4		No			Yes
P	Flowering Plants	Baja Navarretia	*Navarretia peninsularis*	G3		No		5	No
P	Flowering Plants	Short Joint Beavertail	*Opuntia basilaris var. brachyclada*	T3		No		47	Yes
P	Flowering Plants	Matted Cholla	*Opuntia parishii*	G3		No		10	No
P	Flowering Plants		*Opuntia x curvispina*	G3		No		3	No
P	Flowering Plants	Watson's Oxytheca	*Oxytheca watsonii*	G3		No		3	No
P	Flowering Plants	Skunk-top Scurfpea	*Pediomelum mephiticum*	G3		No		20	No
P	Flowering Plants	Bicolored Beardtongue	*Penstemon bicolor ssp. bicolor*	T2		No		39	Yes
P	Flowering Plants	Death Valley Beardtongue	*Penstemon fruticiformis ssp. amargosae*	T3		No		38	Yes
P	Flowering Plants	Keck's Beardtongue	*Penstemon leiophyllus var. keckii*	T2		No		25	Yes
P	Flowering Plants	Jaeger's Beardtongue	*Penstemon thompsoniae ssp. jaegeri*	T2		No		27	Yes
P	Flowering Plants	Delicate Rockdaisy	*Perityle megalocephala var. intricata*	T3		No		84	Yes
P	Flowering Plants	Shining Sandpaper-plant	*Petalonyx nitidus*	G4		No			Yes
P	Flowering Plants	Death Valley Sandpaper-plant	*Petalonyx thurberi ssp. gilmanii*	T2		No		20	Yes
P	Flowering Plants	Barneby's Scorpionweed	*Phacelia barnebyana*	G3		No		9	No
P	Flowering Plants		*Phacelia petrosa*	G3		No		3	No
P	Flowering Plants	Cliff Cinquefoil	*Potentilla rimicola*	G3		No		2	No
P	Flowering Plants	Canyon Live Oak	*Quercus chrysolepis*	G5		No			Yes
P	Flowering Plants	Clokey's Mountain Sage	*Salvia dorrii var. clokeyi*	T3		No		37	Yes
P	Flowering Plants	Eight-spine Fishhook Cactus	*Sclerocactus johnsonii*	G3		No		9	No
P	Flowering Plants	Southern Skullcap	*Scutellaria bolanderi ssp. austromontana*	T2		No		1	Yes
P	Flowering Plants	Rocky Mountain Checker-mallow	*Sidalcea neomexicana*	G4		No		2	Yes
P	Flowering Plants	Nevada Goldenrod	*Solidago spectabilis*	G4		No		2	Yes
P	Flowering Plants	Rusby's Desert Mallow	*Sphaeralcea rusbyi ssp. eremicola*	T1		No		22	Yes
P	Flowering Plants	Striped Horsebrush	*Tetradymia argyraea*	G4		No			Yes
P	Flowering Plants	Charleston Ground-daisy	*Townsendia jonesii var. tumulosa*	T3		No		52	Yes
P	Flowering Plants	Bright Yellow Violet	*Viola aurea*	G3		No		1	Yes
P	Flowering Plants	Charleston Violet	*Viola charlestonensis*	G3		No		19	Yes
P	Mosses		*Crossidium seriatum*	G3		No		8	No

Appendix 5. Terrestrial Coarse-Filter Conservation Elements with Potentially Nested Species Elements for Mojave Basin and Range Ecoregion

Ecosystem	Taxonomic Group	Common Name	Scientific Name
Great Basin Pinyon-Juniper Woodland	Birds	Hepatic Tanager	*Piranga flava*
	Butterflies and Skippers	Nevada Admiral	*Limenitis weidemeyerii nevadae*
	Flowering Plants	Charleston Milkvetch	*Astragalus oophorus var. clokeyanus*
	Flowering Plants	Pacific Greasebush	*Glossopetalon pungens*
	Flowering Plants	Holmgren Lupine	*Lupinus holmgrenianus*
	Flowering Plants	Pahute Mesa Beardtongue	*Penstemon pahutensis*
Inter-Mountain Basins Mixed Salt Desert Scrub	Flowering Plants	Sand Linanthus	*Linanthus arenicola*
Mojave Mid-Elevation Mixed Desert Scrub	Birds	Merlin	*Falco columbarius*
	Birds	Inyo California Towhee	*Pipilo crissalis eremophilus*
	Birds	Bendire's Thrasher	*Toxostoma bendirei*
	Birds	Crissal Thrasher	*Toxostoma crissale*
	Ferns and relatives	Southwestern False Cloak Fern	*Argyrochosma limitanea ssp. limitanea*
	Flowering Plants	Ivory Spined Agave	*Agave utahensis var. eborispina*
	Flowering Plants	Clark Mountain Agave	*Agave utahensis var. nevadensis*
	Flowering Plants	White Bear-poppy	*Arctomecon merriamii*
	Flowering Plants	Cima Milkvetch	*Astragalus cimae var. cimae*
	Flowering Plants	Intermountain Evening-primrose	*Camissonia megalantha*
	Flowering Plants	Gilman Cymopterus	*Cymopterus gilmanii*
	Flowering Plants	July Gold	*Dedeckera eurekensis*
	Flowering Plants	Nine-awned Pappus Grass	*Enneapogon desvauxii*
	Flowering Plants	Ripley's Gilia	*Gilia ripleyi*
	Flowering Plants	Bashful Four-o'clock	*Mirabilis pudica*
	Flowering Plants	Blue Diamond Cholla	*Opuntia whipplei var. multigeniculata*
	Flowering Plants	Death Valley Beardtongue	*Penstemon fruticiformis ssp. amargosae*
	Flowering Plants	Delicate Rockdaisy	*Perityle megalocephala var. intricata*
	Flowering Plants	Aven Nelson's Phacelia	*Phacelia anelsonii*
	Mammals	Allen's Big-eared Bat	*Idionycteris phyllotis*
	Mammals	Desert Bighorn Sheep	*Ovis canadensis nelsoni*
	Reptiles	Speckled Rattlesnake	*Crotalus mitchellii*
	Reptiles	Mohave Rattlesnake	*Crotalus scutulatus*
	Reptiles	Panamint Alligator Lizard	*Elgaria panamintina*
	Reptiles	Desert Night Lizard	*Xantusia vigilis*

Ecosystem	Taxonomic Group	Common Name	Scientific Name
North American Warm Desert Badland	Birds	Kentucky Warbler	*Oporornis formosus*
North American Warm Desert Pavement	Birds	Inca Dove	*Columbina inca*
North American Warm Desert Wash	Flowering Plants	Coachella Valley Milkvetch	*Astragalus lentiginosus var. coachellae*
Sonora-Mojave Creosotebush -White Bursage Desert Scrub	Amphibians	California Red-legged Frog	*Rana draytonii*
	Birds	Loggerhead Shrike	*Lanius ludovicianus*
	Birds	Lucy's Warbler	*Vermivora luciae*
	Flowering Plants	Smallflower Androstephium	*Androstephium breviflorum*
	Flowering Plants	Chihuahuan Ringstem	*Anulocaulis leiosolenus*
	Flowering Plants	Sand Milkvetch	*Astragalus geyeri var. triquetrus*
	Flowering Plants	Holmgren's Milkvetch	*Astragalus holmgreniorum*
	Flowering Plants	Desert Cymopterus	*Cymopterus deserticola*
	Flowering Plants	Panamint Daisy	*Enceliopsis covillei*
	Flowering Plants	Sticky Buckwheat	*Eriogonum viscidulum*
	Flowering Plants	Rock Lady	*Holmgrenanthe petrophila*
	Flowering Plants	Eureka Dunes Evening-primrose	*Oenothera californica ssp. eurekensis*
	Flowering Plants	Beaver Scurf-pea	*Pediomelum castoreum*
	Flowering Plants	Nevada Goldenrod	*Solidago spectabilis*
	Flowering Plants		*Sphaeralcea gierischii*
	Reptiles	Mojave Fringe-toed Lizard	*Uma scoparia*
Sonora-Mojave Semi-Desert Chaparral	Amphibians	Arroyo Toad	*Bufo californicus*

Appendix 6. Aquatic Coarse-Filter Conservation Elements with Potentially Nested Species Elements for Mojave Basin and Range Ecoregion

Ecological System	Taxonomic Group	Common Name	Scientific Name
Mojave Desert Springs and Seeps	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*
	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*
	Freshwater and Anadromous Fishes	White River Springfish	*Crenichthys baileyi baileyi*
	Freshwater and Anadromous Fishes	Hiko White River Springfish	*Crenichthys baileyi grandis*
	Freshwater and Anadromous Fishes	Moapa White River Springfish	*Crenichthys baileyi moapae*
	Freshwater and Anadromous Fishes	Devil's Hole Pupfish	*Cyprinodon diabolis*
	Freshwater and Anadromous Fishes	Ash Meadows Pupfish	*Cyprinodon nevadensis mionectes*
	Freshwater and Anadromous Fishes	Warm Springs Amargosa Pupfish	*Cyprinodon nevadensis pectoralis*
	Freshwater and Anadromous Fishes	Cottonball Marsh Pupfish	*Cyprinodon salinus milleri*
	Freshwater and Anadromous Fishes	Pahrump Poolfish	*Empetrichthys latos latos*
	Freshwater and Anadromous Fishes	A Roundtail Chub	*Gila robusta jordani*
	Freshwater and Anadromous Fishes	Moapa Dace	*Moapa coriacea*
	Freshwater and Anadromous Fishes	Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater and Anadromous Fishes	Pahranagat Speckled Dace	*Rhinichthys osculus velifer*
	Freshwater Snails	Desert Springsnail	*Pyrgulopsis deserta*
	Freshwater Snails	Oasis Valley Springsnail	*Pyrgulopsis micrococcus*
	Freshwater Snails	Southeast Nevada Pyrg	*Pyrgulopsis turbatrix*
	Freshwater Snails	Wong's Springsnail	*Pyrgulopsis wongi*
North American Arid West Emergent Marsh/Pond	Freshwater and Anadromous Fishes	Pahranagat Speckled Dace	*Rhinichthys osculus velifer*
North American Warm Desert Lower Montane Riparian Woodland and Shrubland/Stream	Reptiles	Two-striped Gartersnake	*Thamnophis hammondii*
North American Warm Desert	Amphibians	Yavapai Leopard Frog	*Rana yavapaiensis*
	Freshwater and	Desert Sucker	*Catostomus clarkii*

Ecological System	Taxonomic Group	Common Name	Scientific Name
Riparian Woodland and Shrubland/Stream	Anadromous Fishes		
	Freshwater and Anadromous Fishes	Meadow Valley Wash Desert Sucker	*Catostomus clarkii ssp. 2*
	Freshwater and Anadromous Fishes	Bluehead Sucker	*Catostomus discobolus*
	Freshwater and Anadromous Fishes	Flannelmouth Sucker	*Catostomus latipinnis*
	Freshwater and Anadromous Fishes	Moapa White River Springfish	*Crenichthys baileyi moapae*
	Freshwater and Anadromous Fishes	Mohave Tui Chub	*Gila bicolor mohavensis*
	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*
	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*
	Freshwater and Anadromous Fishes	Roundtail Chub	*Gila robusta*
	Freshwater and Anadromous Fishes	A Roundtail Chub	*Gila robusta jordani*
	Freshwater and Anadromous Fishes	Virgin River Chub	*Gila seminuda*
	Freshwater and Anadromous Fishes	Virgin River Chub - Muddy River Population	*Gila seminuda pop. 2*
	Freshwater and Anadromous Fishes	Virgin Spinedace	*Lepidomeda mollispinis*
	Freshwater and Anadromous Fishes	Virgin River Spinedace	*Lepidomeda mollispinis mollispinis*
	Freshwater and Anadromous Fishes	Moapa Dace	*Moapa coriacea*
	Freshwater and Anadromous Fishes	Woundfin	*Plagopterus argentissimus*
	Freshwater and Anadromous Fishes	Colorado Pikeminnow	*Ptychocheilus lucius*
	Freshwater and Anadromous Fishes	Speckled Dace	*Rhinichthys osculus*
	Freshwater and Anadromous Fishes	Moapa Speckled Dace	*Rhinichthys osculus moapae*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater and Anadromous Fishes	Pahranagat Speckled Dace	*Rhinichthys osculus velifer*
	Freshwater and Anadromous Fishes	Razorback Sucker	*Xyrauchen texanus*
	Reptiles	Southern Pacific Pond Turtle	*Actinemys marmorata pallida*
	Reptiles	Two-striped Gartersnake	*Thamnophis hammondii*
Reservoir	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*
	Freshwater and	Razorback Sucker	*Xyrauchen texanus*

Ecological System	Taxonomic Group	Common Name	Scientific Name
	Anadromous Fishes		